UNIVERSITY OF MIAMI

POLICY, LIABILITY, AND MANAGEMENT ASSESSMENT OF THE THREE MOST ACTIVE COUNTIES'(DADE, BROWARD, AND PALM BEACH) ARTIFICIAL REEF PROGRAMS UNDER NATIONAL AND STATE GUIDANCE

By

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Policy, Liability, and Management Assessment of the Three Most Active Counties' (Dade, Broward, and Palm Beach) Artificial Reef Programs Under National and State Guidance.

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Despite the national and states' eagerness to support artificial reef development, local governments lack scientific, systematic, and practical information regarding artificial reef construction. Especially, due to the shortage of funds for research and monitoring, political expediency for attracting tourist divers and fishermen, disposal of "materials of opportunity," many of the artificial reefs sunk in the United States have been haphazardly procured.

In this review, four future priorities are recommended to help solve proper contemporary reef management issues. First, a master plan for each specific-site-reef project must be developed to be anticipated how it could be now and in the future. Second, a more centralized artificial reef development system is needed to achieve the state-wide reef objectives of control and regulation. Third, a reef complex generated by accumulation of reef groups are encoureged because it provides more independent ecological functions than an individual reef. Finally, establishment of local or regional artificial reef advisory committees are strongly recommended to provide input and expertise by their members.

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PREFACE

Since the late 1970's, public enthusiasm for artificial reef deployment has escalated rapidly in the United States. In response to this, Congress enacted the National Fishing Enhancement Act in 1984 (see Appendix A), which directed the Secretary of Commerce to develop a national artificial reef plan.

Despite this growing nation-wide public interest, most coastal states have not developed comprehensive artificial reef management plans. However, the State of Florida drafted the Florida Artificial Reef Development Plan in 1992. In fact, the Florida Department of Environmental Protection, the Army Corps of Engineers, and the U.S. Coast Guard have played major roles in developing artificial reefs in Florida waters. At the county level, among 30 reef counties, Dade, Broward, and Palm Beach have been most active in artificial reef deployment.

In this context, my research examines how the national, state, and local governments' reef policies are inter-related, what kind of tort theories could be applied to injuries and damages associated with artificial reef development, and which management tools are most efficient and cost wise.

Under the direct supervision of Dr. James Bohnsack of the Southeast Fisheries Center, NMFS, NOAA, I prepared twenty-five general research questions in three different areas: policy, liability, and management (see Appendix B). Then, I divided them into four biological questions (see Appendix C), five legal

questions (see Appendix D), fifteen general questions at the state level (see Appendix E), and seventeen general questions at the county level (see Appendix F).

Questions that I selected in interviews with local artificial reef experts are followed by the Internship Research Calendar (see Appendix G). In September 1994, I visited Tallahassee to interview Jon Dodrill, the FDEP Artificial Reef Coordinator. I also stopped at the Jacksonville District of the Army Corps of Engineers and obtained an update of reef permitting regulations.

In October, I participated in the Artificial Reef Coordinators' Meeting in Sarasota, at which Dr. Bill Lindberg's Suwannee River Artificial Reef Project was presented. Also, three staff members from the Reef Ball Development Group, Ltd., demonstrated how to mold reef balls (see Appendix H).

Through personal meetings with artificial reef coordinators and local biologists, I had the privilege of garnering important current reef information. Furthermore, during the weekly meetings with my supervisor, I closely scrutinized and finely tuned all of the reef data collected in the field.

Consequently, I hope this paper will bring useful information to bear upon and sharpen attention to the proper reef building for ultimately enhancing natural resources.

D.S. Jang 1995

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ACRONYMS

ACE	Army Corps of Engineers
BTIITF	Board of Trustees of the Internal Improvement Trust Fund of Florida
CFRDA	Commercial Fisheries Research and Development Act
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DERM	Department of Environmental Resources Management of Dade County
DNRP	Department of Environmental Resources Protection of Broward County
DOC	Department of Commerce
DOD	Department of Defense
DOI	Department of Interior
DOT	Department of Transportation
EPA	Environmental Protection Agency
FARDP	Florida Artificial Reef Development Plan
FAFRP	Florida Artificial Fishing Reef Program
FDEP	Florida Department of Environmental Protection
FDER	Florida Department of Environmental Regulation
FDNR	Florida Department of Natural Resources
FTCA	Florida Tort Claims Act
FWA	Fish and Wildlife Act
FWS	Fish and Wildlife Service
MFCMA	Magnuson Fishery Conservation and Management Act
MMS	Minerals Management Service
MPRSA	Marine Protection, Research, and Sanctuaries Act
NARP	National Artificial Reef Plan
NEPA	National Environmental Policy Act
NFEA	National Fishing Enhancement Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OCSLA	Outer Continental Shelf Lands Act
ODA	Ocean Dumping Act
RHA	Rivers and Harbors Act
SEFC	Southeast Fisheries Center
SLA	Submerged Lands Act
USCG	United States Coast Guard

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INTRODUCTION

In the United States, artificial reefs have been deployed for over 150 years[1] mainly targeting multi-species for recreational interests, unlike Japan, which has mostly advanced them for over 200 years[2] as enhancing commercially valuable mono-species for fishery harvests. During the 1970's and the early 1980's, under growing national public interest in environmental protection and natural resources preservation, several congressional actions have incited "public enthusiasm for artificial reef"[3] deployment, in light of creation of the National Marine Fisheries Service (NMFS),[4] enactment of the Magnuson Fishery Conservation and Management Act[5] (MFCMA) in 1976, establishment of eight regional fishery councils[6] mandated by MFCMA, and the codification of the National Fishing Enhancement Act[7] (NFEA) in 1984.

As of 1985, when the National Artificial Reef Plan (NARP) was developed with comprehensive guidelines and criteria for facilitating appropriate artificial reef development, artificial reef construction in the United States has entered a new phase based on systematic scientific research and recreational and commercial utilization.[8] This national plan encourages states to participate in developing their own site-specific plans and

maintaining regulatory control. With this encouragement, the State of Florida has made great efforts in drafting a comprehensive state-level artificial reef development plan[9] and guidelines for technical evaluation of fish habitats.[10]

In the wave of ceaseless public demand and both national and state-level eagerness for artificial reef development, more than 30 counties in Florida[11] have developed numerous artificial reefs offshore in the Gulf of Mexico, the Atlantic, and the Florida Keys. This popularity has boomed because artificial reef deployment has been acceptable for a variety of reasons such as mitigation,[12] habitat enhancement,[13] reduction of user pressure on natural reefs,[14] disposal of "materials of opportunity,"[15] increased production of fish stocks,[16] improved economic performance,[17] attraction of recreational activities,[18] and promotion of efficiency.[19]

Despite the potential and explicit beneficial measures for artificial reef development, little regarding long-term adverse environmental consequences is known about impacts on biological and ecological fish habitats,[20] issues on disguised disposal of certain types of "materials of opportunity,"[21] and aesthetically displeasing underwater scenery. In order to properly address controversies arising from artificial reef deployment, three major areas will be analyzed in this review: policy and

permitting procedures, liability concerns, and management assessment. Dade, Broward, and Palm Beach County's artificial reef programs will receive the bulk of the attention throughout the analyses, since they are the most active local governments in developing artificial reefs in Florida waters.

CHAPTER 1
POLICY AND PERMITTING PROCEDURES

1. National Artificial Reef Plan

In 1972, the federal government expressed a desire to facilitate a national-level artificial reef development plan by legislating P.L. 92-402.[22] Pursuant to section 3(a), the Secretary of Commerce would provide surplus World War II Liberty ships to the states to use as offshore artificial reefs for the conservation of marine life.

In the mid-1980's, the federal government realized that properly designed and constructed artificial reefs could help resolve numerous problems confronting federal and state fishery management. In response to this sentiment, Congress passed the NFEA[23] in October 1984, requiring the Secretary of Commerce to develop a long-term national artificial reef plan. The NFEA established national standards and direction for responsible artificial reef construction in U.S. navigable waters. In accordance with the NFEA, Title II, section 203, artificial reefs must be sited, constructed, monitored, and managed, based on the

best scientific data available, in a manner that will:

1) enhance fishery resources to the maximum extent practicable;
2) facilitate access and utilization by United States recreational and commercial fishermen;
3) minimize conflicts among competing uses of waters covered under the [NFEA, Title II] and the resources in such waters;

4) minimize environmental risks and risks to personal health and property; and
5) be consistent with generally accepted principles of international law and not create any unreasonable obstruction to navigation.[24]

Pertinent to this directive, the Secretary of Commerce, through the NMFS under NOAA, produced the NARP[25] in November, 1985. It was developed in consultation with many federal agencies[26] concerned in reviewing and approving federal permits for artificial reef development and with substantial assistance from states, local governments, and the public. The NARP characterizes the federal role to provide technical advice, guidance, regulations, and encouragement for the proper uses of artificial reefs by states, local governments, or private entities.[27] The following federal agencies are involved in differing degrees of reviewing and permitting artificial reef construction in U.S. coastal waters.

A. Department of the Interior (DOI)

In 1953, Congress passed the Outer Continental Shelf Lands Act (OCSLA),[28] legislating the Truman Proclamation on the

Continental Shelf of 1945 which declared U.S. sovereign rights over this area.[29] The OCSLA reaffirmed this exclusive jurisdiction over the continental shelf, creating not only comprehensive authority for the Secretary of the Interior[30] to explore and exploit the minerals (oil, gas, and sulphur)[31] through leasing programs, but also the obligation to prevent waste disposal[32] and for the conservaton of the living and non-living resources.[33]

For example, when obsolete oil platforms are transformed to artificial reefs, the Minerals Management Service (MMS) of the DOI is responsible for preparing the environmental impact assessment.[34] In this assessment, the MMS must take into consideration what the Endangered Species Act of 1973 (ESA)[35] and the Marine Mammal Protection Act of 1972 (MMPA)[36] require in terms of the protection of marine animals and plants. Especially, the ESA "Section 7 Consultation"[37] requires that each federal agency initially determine whether any endangered or threatened species is present in the area where the oil platforms are to be removed. If that is the case, then the MMS must consult with the DOI (through the FWS) and the DOC (through the NMFS) to prepare a biological assessment.[38]

Under the Fish and Wildlife Act of 1956 (FWA)[39] and the Commercial Fisheries Research and Development Act of 1964 (CFRDA),[40] Congress established an extensive national fish and

wildlife policy. The FWA mainly authorizes the Secretary of the Interior to develop measures for "maximum sustainable production of fish and fishery products,"[41] to contribute to national economy, and to protect fish and wildlife resources. The CFRDA mandates the Secretary of the Interior to cooperate with the states carrying out programs for research and development of commercial fishery resources in territorial waters.[42]

The Fish and Wildlife Service (FWS) under the DOI is responsible for increasing sport fishing and boating opportunities under the Federal Aid in Sport Fish Restoration Act of 1950.[43] Currently, under the name of Wallop/Breaux federal grant, this division has provided anglers and boaters' tax dollars[44] to the states for fishery resources enhancement projects such as artificial reefs.

B. Department of Commerce (DOC)

By the mid of 1970's, due to the gradual depletion of fishery stocks beyond territorial waters by the growing advanced fishing technology and the international trend to extend offshore fisheries jurisdiction, the passage of the MFCMA[45] in 1976 extended the exclusive U.S. fisheries jurisdiction to 200 nautical miles offshore. The MFCMA authorizes the Secretary of Commerce to oversee eight regional fishery management councils to develop their own fishery management plans.[46] The councils are composed of the regional director of the NMFS and state fishery

management officers, as well as individuals from each state who are recommended by state governors and appointed by the Secretary of Commerce.[47]

The FWA and CFRDA also assign authority for the Secretary of Commerce, through the NOAA, to maintain and increase the public opportunities for commercial and recreational uses of fish and wildlife resources.[48] Specifically, in 1985, the NMFS under NOAA played an active role in preparing the comprehensive NARP mandated by the NFEA of 1984.

C. Department of Defense (DOD)

Traditionally, the DOD is responsible for protecting national security and maintaining navigational capacity in U.S. navigable waters. Under section 10 of the Rivers and Harbors Act of 1899 (RHA),[49] the Army Corps of Engineers (ACE), an element of the DOD, has broad regulatory authority over the construction of piers, jetties, and similar structures, or the disposal of dredged and fill materials in U.S. territorial waters. On the other hand, the RHA section 13 prohibits from discharging any refuse in U.S. navigable waters without a permit from the ACE. Further, ACE's regulatory authority is clearly extended beyond the U.S. territorial sea, regulating artificial islands, installations, and other fixed structures located on the outer continental shelf.[50] Hence, the ACE's responsibility for permitting artificial reefs is assigned both in the territorial

sea and on the outer continental shelf.

Whereas section 10 of the RHA gives the ACE basic authority in permitting artificial reef projects, the more specific requirements of legislation such as the Federal Water Pollution Control Act of 1972 (FWPCA)[51] amended by the Clean Water Act of 1977 (CWA),[52] the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA),[53] the National Environmental Policy Act of 1969 (NEPA),[54] and the Coastal Zone Management Act of 1972 (CZMA),[55] are fully integrated into the ACE's permitting consideration.

Section 101 of the CWA established a national goal to eliminate the discharge of pollutants in navigable waterways by 1985.[56] Under this goal, the National Pollutant Discharge Elimination System (NPDES) was created by section 402 of the CWA, under which permits for discharge of pollutants must be approved by the EPA or by the states with EPA authorized programs. Section 404 realizes not only the ACE's traditional function such as permitting for the discharge of dredged or fill materials into navigable waters, but it also directs the ACE to apply water quality standards adopted by the EPA. Section 401 defines that states have veto power over EPA or ACE's permits, if the states have more restrictive water quality standards that are incompatible with those permits.

In 1972, the MPRSA, commonly known as the Ocean Dumping Act (ODA), was enacted "to regulate the dumping of all types of

materials into ocean waters," and to prevent or strictly limit any ocean dumping of certain materials which might affect adverse impacts on human and marine life.[57] Under the ODA, ACE's authority is reaffirmed for permitting the discharge of dredged or fill materials into U.S. waterways, whereas the EPA is empowered for permitting the disposal of any other non-dredged types of pollutants.

The NEPA, signed in 1969, may turn out to be the most instrumental environmental law. The NEPA requires that all federal agencies, before undertaking major actions that could significantly affect the quality of human environment, prepare environmental impact statements to avoid or mitigate adverse environmental consequences.[58] Prior to the NEPA, the ACE was traditionally concerned about the promotion of channels in harbors and the review of navigable capacity of the nation's waterways.[59]

In 1970, however, the U.S. Fifth Circuit Court of Appeals ruled in *Zabel v. Tabb*[60] that, in the ACE's permit reviewing process, ecological factors should be taken into consideration. Since then, the ACE has been able to reject a permit application, if it finds that adverse environmental effects might result from such activities.

In 1972, Congress passed the CZMA, which established a program that has allowed federal funding for coastal states to

develop their own coastal zone management programs. The CZMA provides the coastal states with a flexible approach in administrating their programs. Especially, with respect to artificial reef development plans, the "federal consistency "[61] provision in the CZMA is an important mandate requiring that federal agencies' actions, such as the ACE, be consistent with the federally approved coastal zone management program of the state.

D. Department of Transportation (DOT)

The U.S. Coast Guard (USCG), an element of the DOT, has the prime responsibility to establish aids to navigational safety for commerce, naval mobility, and recreational activities. Thus, it exercises regulatory authority over artificial reef deployment in navigable waters in relation to proper buoy markings and navigational clearance.[62] Without the USCG's authority, neither the establishment, erection, nor maintenance of any aids to navigation can be allowed.[63] Otherwise, penalties are prescribed for establishing unauthorized aids to maritime navigation.[64]

With regards to artificial reef construction, the main role of the USCG is in the deploying of mechanical or motorized devices such as steel vessels, airplanes, and military equipment, which may contain pollutants such as oil, gas, and grease, as well as other contamiants. The Marine Inspection Office of the USCG is directly responsible to insure that the vessel is

examined and free of any presence of hazardous materials, inter alia, oil, gas, and chemicals. The Marine Safety Office will establish a security zone around the vessel-sinking location to insure the safety of people aboard spectator crafts.[65]

E. Environmental Protection Agency (EPA)

The EPA, in general, acts as a review agency for ACE's reef permits only if those materials are deposited under the water quality criteria promulgated by the EPA. Although the EPA does not have oversight authority over the ACE's dumping permits,[66] if the EPA declines to concur in terms of application of water quality standards, the ACE may not issue the permits. Conversely, if the ACE issues dumping permits in accordance with MPRSA's requirements, the EPA must not intervene in the ACE's discretionary decision, unless it finds that the "dumping...will result in an unacceptably adverse impact on municipal water supplies, shellfish beds, wildlife, fisheries..., or recreational areas."[67]

At this point, two questions are bound to be raised. What kinds of reef materials must be regulated before dumping? And how does the MPRSA define dumping? To the first, the MPRSA requires the EPA and the ACE to regulate all materials dumped into U.S. navigable waters.[68] In this context, which types of materials will be allowed to be dumped, which will not, and which will be exempted from regulations? Materials such as solid wastes,

industrial wastes, radioactive wastes, sewage, sludge, incinerator residue, and dredged materials, must be regulated by the EPA and the ACE before dumping into ocean waters. Furthermore, the MPRSA prohibits high-level radioactive and medical substances and chemical and radiological wastes from being dumped into navigable waters.[69]

However, the MPRSA excludes effluent from ocean sewage, outfalls, construction of any fixed structure or artificial island, and the deposit of oyster shells or other materials for the purpose of developing fishery resources from dumping regulations.[70] This provision connotates that deployments into ocean waters for purposes other than disposal are not 'dumping,' so that they may be excluded from the regulations of the MPRSA. As a result, one of the major criticisms of this equivocal definition is that reef builders and waste material managers can easily find a loop-hole for the disguised disposal of industrial wastes under the name of fishery resources enhancement.

2. Florida Artificial Reef Development Plan

The degree of state-level involvement in artificial reef development ranges from direct efforts to construct artificial reefs to support as a guardian for the local governments' artificial reef programs. To achieve the maximum goals, the NARP suggests that "appropriate state agencies play a major role in the development of national and site-specific guidelines for

artificial reefs."[71] In response, the State of Florida--through then its Department of Natural Resources (FDNR),[72] Division of Marine Resources, Office of Fisheries Management and Assistance Services--has comprehensively formulated the Florida Artificial Reef Development Plan (FARDP). In the same manner with the NARP, the FARDP provides general guidelines for individual counties or regions to prepare their own site-specific plans based on local needs and management strategies.[73]

Prior to the creation of the FARDP, in November 1987, various reef-building communities met in Miami for the First Florida Artificial Reef Summit.[74] The participants in this meeting assuredly supported the necessity of an expanded state-level artificial reef program for a centralized permitting system to help county-level artificial reef programs implement the statewide plan.[75] The First Summit produced numerous artificial reef management needs, but the Florida congressional legislative backing was not then ready to fund the operation. In the spring of 1989, however, the Saltwater Fishing License Bill (HB 2033) was passed in Florida,[76] possibly providing a basis for reliable reef funding and for a statewide plan.

In January 1990, the Second Florida Artificial Reef Summit was held in Tallahassee, which reemphasized the need for written standards and procedures, with even stricter permit conditions. In time, Florida State Legislature showed a will to support a

statewide artificial reef plan. They subsequently passed legislation that created the Florida Artificial Fishing Reef Program (FAFRP).[77] It provided that the state should provide grants to coastal local governments for the construction of artificial reefs.[78] According to the mandates on the FAFRP section 2 and 3, the FDNR developed Comprehensive Artificial Reef Program code in 1990[79] and drafted the FARDP in 1992.

Early in 1994, Florida State Representative Ritchie[80] and Senator Dantzler[81] presented bills to the Florida House and Senate Natural Resources Committees, respectively, amending the FAFRP to assign responsibility for the artificial-fishing-reef program to the FDEP; to provide procedures for permitting the construction of artificial reefs in certain areas of the state; and to provide criminal penalties. This proposed legislation drew the southwest artificial reef coordinators' attention, who have expected that as to be more restrictive. They concluded that some of the changes would be positive, but others deleterious. Thereafter, artificial reef coordinators in southwest Florida and the Florida Sea Grant faculty prepared the *Impact of Proposed Legislation on Florida's Artificial Reef Program*[82] to inform and advise their local governments and legislative delegations of the potential impact and ramifications of this proposed legislation to the future of Florida's artificial reef program.

Florida Department of Environmental Protection

Prior to July 1, 1975, the effective date of the Florida Environmental Reorganization Act,[83] the Board of Trustees of the Internal Improvement Trust Fund (BTIITF)[84] had enforcement and management responsibilities and permitting authority for Florida sovereign submerged lands. After the reorganization of the state governmental structures in 1975, the BTIITF retained the fiduciary responsibilities of managing state submerged lands. However, the Florida Department of Environmental Regulations (FDER) took over jurisdictional authority over the issuance of artificial reef permits.

Simultaneously, the FDNR had responsibilities to review all reef applications. The FDER could not decide whether or not to permit without considering FDNR's recommendations.[85] According to the Sovereignty Submerged Lands Management code,[86] a 'consent of use' (letter of consent) is required from Division of State Lands in the FDNR for local counties' artificial reef building in territorial waters of Florida.[87]

As of July 1, 1993, all of the existing legal authorities and functions of the FDER and the FDNR were eventually merged into the Florida Department of Environmental Protection (FDEP).[88]

3. Local Governments (Dade, Broward, and Palm Beach County)

In Florida, local county governments have been involved

actively in directing or coordinating artificial reef deployment. The NARP defines the local government's role in artificial reef development as coordinating "materials of opportunity," providing technical support for private entities, raising funds, obtaining state and federal funds for local reef construction and transportation, and publicizing local reef efforts.[89] Among many coastal counties in Florida, three counties--Dade, Broward, and Palm Beach--have engaged in artificial reef development affairs most actively, aiming for attraction of tourist divers and recreational fishermen.

According to the survey in *Artificial Reef Evaluation Capabilities of Florida Counties*[90], the degree of artificial reef program capacity at the county level can be classified into three categories: (1) "Special Office"--a designated reef office with salaried staff and space for files and equipment, (2) "Added Task"--no special office but additional duty for some salaried staff, and (3) "Volunteers"--volunteers working in cooperation with county staff.[91] Dade, Broward, and Palm Beach County's artificial reef programs were indicated as belonging to the "Added Task" group.[92]

Since 1981, the Dade County Artificial Reef Program has performed under the auspices of the Department of Environmental Resources Management (DERM), Natural Resources Division, Restoration and Enhancement Section. Ben Mostkoff is the only

full-time staff who has main responsibility for coordinating artificial reefs, although the section, which includes about 17 employees, utilize each other's expertise in mitigation projects, beach renourishment, bay water quality monitoring, reef damage assessment, and fishery management issues.[93]

No full-time employee works for the Broward County Artificial Reef Program. Instead, it is coordinated by three part-time staff. Among them, Ken Banks is the lead agent, working in the Department of Natural Resources Protection (DNRP), Biological Resources Division, Marine Resources Section. These staff members do not work only on artificial reef development, but they also set aside time to look after beach erosion, sea turtle protection, and any other marine resource issues.[94]

The Artificial Reef Program for Palm Beach County was started in 1985 when the Board of County Commissioners created the Artificial Reef Committee. These commissioners gave the Palm Beach County DERM responsibilities for administrating artificial reef programs in conjunction with the Artificial Reef Committee. Jim Vaughn works full-time in the DERM, Coastal and Wetland Division, Environmental Enhancement Section, along with four other part-time employees.[95]

4. General Permit System

All reef builders are required to obtain appropriate permits

when developing new reef sites and timely renewal of existing permits if needed for additional construction at already established sites. The permitting process starts by submitting to the FDEP a Joint Application for generating reef sites in the waters of Florida.[96] The FDEP acts as the lead agency in receiving and distributing copies of reef applications to other state and federal agencies for review. Although a single Joint Application form is submitted to be approved, separate written permits must be obtained from each applicable agency before reef construction commences.[97] If reef builders plan to deposit materials in the Florida State water, they are required to obtain a separate written permit from the FDEP and the ACE. However, if they are planning to do it beyond the state's water, solely ACE's permit is required--even if the FDEP will have application review privileges.[98]

On April 11, 1984, the Jacksonville District of the ACE issued a General Permit SAJ-50 system, which has been typically required for all artificial fishing reefs and fish attractors in Florida, the Commonwealth of Puerto Rico, and the U.S. Territory of the Virgin Islands.[99] In this scheme, general permit conditions and criteria were pre-developed to facilitate the permit review and approval process. Thus, a reef permit will be granted if the proposed reef project meets these pre-approved basic criteria.[100]

The reason why a single application form and a general permit system have been designed for use by all the applicable agencies is to minimize delays, efforts, and paper work.[101] Conversely, unless the proposed project meets the general permit's (SAJ-50) criteria, a regular or individual permit may be required and will probably prolong the approval process.[102] Under normal processing conditions, a permit may be issued within 60-90 days from the submission of the application.[103]

In addition, copies of a Joint Application will be provided to a number of reviewing federal agencies: the USCG, who is interested in markings and navigational safety requirements; the EPA, who might interfere with the reef material discharge that is incompatible with water quality standards; the FWS and the NMFS, interested in fishing and general environmental concerns; and the Air Force, Navy, and NASA, using the ocean waters for military purposes or for the space program.[104] Copies also are dispensed to appropriate state agencies,[105] such as the Division of State Lands, the Division of Beaches and Shores Permiting, and the Bureau of Land and Aquatic Resources Management, and to the applicable regional fisheries management councils.[106]

CHAPTER 2
LIABILITY CONCERNS REGARDING ARTIFICIAL REEF DEVELOPMENT IN THE U.S. NAVIGABLE WATERS

Liability is an ongoing concern for artificial reef deployment in the United States[107] to both reef permittees and permitters, because it might become a restraint to the reef development, especially to private reef builders who have the burden of showing the proof of financial ability such as insurance and assets for any would-be liability law suits.[108] The NFEA, Title II, section 205(c) and (d) address the liability issue from the perspective of the reef permittee, material donor, and federal government.

First of all, the NFEA notices that the permittee and any permittee's insurer could be excluded from the liability for any damage if they comply with the terms and conditions of the permit.[109] Conversely, the permittee and the insurer are liable for damages caused by activities beyond the terms and conditions of the permit.[110] Therefore, a potential permittee, before a reef permit is issued, must "demonstrate the financial ability to assume liability for all damages that may arise with respect to an artificial reef."[111]

Second, the material donor is not liable for damages arising from the use of such materials if they have already transferred

the title to the permittee and "such materials meet applicable requirements of the [National Artificial Reef Plan]...and are not otherwise defective at the time title is transferred."[112]

Finally, with respect to the federal government, the NFEA states no liability on the part of the United States. Instead, the NFEA mandates a stringent permit issuance for the Secretary of the Army through consultation with appropriate federal and state agencies[113] to ensure the permittee's plan for siting, constructing, monitoring, and managing the artificial reef based on all applicable criteria.[114] This is to ensure the use of proper artificial reef materials,[115] to consider the NARP's recommendations, and to notify any need to deviate from the reef permit criteria.[116]

The NARP sets in array seven potential risks of injuring persons and damaging property and natural resources caused by improper artificial reef construction:

> (1) injuries to personnel handling the reef materials;
> (2) damage to vessels transporting reef materials;
> (3) improper location causing damage to fishing gear;
> (4) damage to vessels in transit over the reef;
> (5) injury to recreational divers;
> (6) decomposition or movement of the reef material to an unauthorized location; or
> (7) environmental hazards caused by incomplete cleaning of hulls or holds containing toxic residues.[117]

One more was added to the above list by the FARDP: (8) "placing materials in the wrong place or in an unauthorized area."[118]

Who is liable for the above injuries or damages? To date,

nobody could clearly answer this question, because no liability case arising from injuries or damages associated with artificial reef development has been brought to the courts.[119] Thus, to predict how the courts will decide on the above question, one can only hypothesize situations that might invoke law suits during actual artificial reef construction projects in navigable waters of the United States.

Presumably, according to the NARP, potential injuries or damages related to artificial reef deployment are likely to happen in three stages: (1) plan and permit stage, (2) construction stage, and (3) monitoring stage.[120] Similarly, Collins applies tort theories such as negligence, nuisance, and strict liability to three different stages: (1) siting, (2) transportation to site, and (3) on site.[121]

Because of "a dearth of case law involving artificial reefs"[122] and the slack interpretation of liability by the NFEA,[123] one should refer to admiralty law, sovereign immunity, and traditional tort theories to track the answers for the above question.[124] Accordingly, with respect to liability concern, this chapter will discuss tort theories and governmental sovereign immunity. At first, an attempt will be made to explicate clearly the jurisdictional boundaries between the federal and state waters.

1. Jurisdictional Boundaries Between Federal

and State Waters

A. Submerged Lands Act[125]

Since the late 1930's, controversies have emerged surrounding oil and gas discovery from submerged lands in California offshore and ownership of those minerals. On October 19, 1945, the United States filed a lawsuit in the U.S. Supreme Court against the State of California to determine which government could own them, or had paramount rights in and over the submerged lands off the coast of California.[126] The Supreme Court held in favor of the federal government that the paramount rights within the U.S. territorial sea remained in the United States,[127] on the ground of national security, commerce, and foreign affairs.[128]

Despite this Supreme Court ruling, a great controversy in Congress did not cease concerning the mineral resources ownership issue within U.S. territorial waters. In 1953, Congress finally enacted the Submerged Lands Act (SLA), which released and relinquished to the coastal states all federal proprietary rights and claims in the three nautical mile territorial sea, except the federal navigational servitude and control of navigable waters and their submerged lands "for the Constitutional purpose of commerce, navigation, national defense, and international affairs."[129] Therefore, the SLA confirmed three purposes: (1) state title to the territorial sea, (2) outer limit of state

ocean boundaries, and (3) still most aspects of federal authority both within and beyond the three mile territorial sea.[130]

In addition, the SLA section 1301(2) and 1312 admits any coastal state, except the original thirteen states, to be able to extend their ocean boundaries beyond three geographical miles, if it could prove that "it was so provided by constitution or laws prior to or at the time such state became a member of the Union, or if it has been heretofore approved by Congress."[131] The SLA left this claim to the courts to determine whether a state could establish a historic claim beyond three nautical miles.

As a result, only Texas and Florida were able to establish such claims beyond three nautical miles. In 1960, the Supreme Court recognized the three marine leagues (9 nautical miles) boundaries in the Gulf of Mexico of both Florida--based on Congressional approval in 1868 constitution--and Texas--based on its historic claim.[132] In this context, Florida State can have jurisdictional authority to control and manage all the artificial reef development activities within three nautical miles of the Atlantic and nine nautical miles of the Gulf of Mexico.

B. Outer Continental Shelf Lands Act[133]

Congress subsequently passed the OCSLA, confirming the federal government's exclusive jurisdiction and control over the seabed and its subsoil beyond the state territorial limits.[134] While the OCSLA authorizes the DOI to explore and produce oil and

gas-- through a leasing program--for the United States public,[135] the DOD, through the ACE, is authorized to eliminate any navigational obstruction in the U.S. navigable waters, extending its authority to regulate the "artificial islands, installations, and other devices" permanently or temporarily attached to the seabed on the outer continental shelf.[136] Therefore, permitting authority of deploying artificial reefs beyond the state jurisdictional boundaries pertains solely to the federal government.

C. Federal Preemption Versus State Action

Today, the SLA confirms the state jurisdictional "right and power to manage, administer, lease, develop, and use the [submerged] lands and natural resources" within territorial waters.[137] However, even until 1976 when Congress expressed dominant interest in fisheries management up to 200 nautical miles by enacting the MFCMA,[138] historically, coastal states had exercised their jurisdictional power over fisheries management "by virtue of the police power" in inland waters and the territorial waters since colonial time.[139]

In early 1941, the *Skiriotes v. Florida*[140] case ensured the rights of a coastal state to regulate and govern its citizen's fishing activities beyond the territorial waters. Appellant Lambiris Skiriotes in Pinellas County, Florida, was using apparatus forbidden by the Florida regulation for sponge catching

in the federal waters at approximately six marine leagues (about 18 nautical miles) from west coast of Florida. In this case, a legal question was brought up: "could the State of Florida regulate its citizen's illegal fishing activities beyond its jurisdictional limits?"

First, the U.S. Supreme Court ruled that the federal law regulating the size of sponges to be taken in federal waters had no conflict with the Florida regulation on the type of sponge fishing gear.[141] Then, the legal concern in this case was moved to the status of the Appellant's citizenship and the conduct of the U.S. citizen as the Florida resident. The court held as follows:

> If the United States may control the conduct of its citizens upon the high seas, we see no reason why the State of Florida may not likewise govern the conduct of its citizens upon the high seas with respect to matters in which the State has a legitimate interest and where there is no conflict with acts of Congress. Same for the powers committed by the Constitution to the Union, the State of Florida has retained the status of a sovereign. Florida was admitted to the Union "on equal footing" with the original states.[142]

Thus, in the absence of conflict with federal regulations, Florida could control the conduct of its citizen beyond territorial waters under the state police power, so long as it has a legitimate interest of the proper maintenance of fishery resources.

Since then, a controversy has emerged from the issue of the

direct state regulation of non-citizens.[143] Especially, the Alaskan Supreme Court considered, in the *State v. Bundrant*,[144] whether *Skiriotes* limited the extraterritorial control over Alaska's offshore crab fishery solely to the residents of Alaska. Because of the importance of offshore crab fishery conservation and the state's legitimate interest in regulation of the those fishery, Alaska has to have authority to regulate effectively both its citizens and non-citizens. Further, if the state is forced to distinguish between them, it will allow the opportunity for Alaskans to transfer their citizenship to another state.[145]

Although the courts ruled for the limited state's extraterritorial jurisdiction, a coastal state should exercise cautiously its purview beyond its jurisdictional boundaries. Christie, in *Coastal and Ocean Management Law*, describes three focusing issues when the court considers whether a federal law preempts state action within federal waters:

> (1) Did Congress intend to occupy the field?
> (2) Is there a conflict?
> (3) Does the state regulation present an obstacle to the goals and purposes of the federal law?[146]

First of all, if Congress intends, by legislating such as the MFCMA, to occupy the entire field of fishery regulation in the EEZ with no room left for state action, then any state fishery regulation in this area is preempted by such laws. Second, federal preemption can prevent a state action if the

state action conflicts with federal regulations. In other words, if it is not problematic to comply with both laws, some courts might withhold no conflict between them. In general, less restrictive federal environmental laws usually do not preempt more conservative state environmental regulations. Finally, federal preemption will occur if a state legislation becomes an obstacle to the objectives of the federal law.[147]

As a current issue, charter boat captains, operating off the Florida Panhandle, have engaged in unpermitted or illegal dumping of solid waste, at night, to create personal fishing spots beyond the state jurisdictional limits. To enforce laws concerning these illegal activities, both the Florida Marine Patrol and the USCG can cite them. But, in practice, it is very difficult to do so unless the illegal dumping is witnessed by a law enforcement team.[148] Considering this difficult circumstance, the State of Florida, if interested, may legislate to prevent such activities under more stringent state regulations, in agreement with the ACE and in corporation with the USCG and the regional fishery management council.

2. Theories of Tort Liability

Kionka, in *Torts in a Nutshell*, states that the term "tort" is an elusive concept.[149] Nevertheless, if one needs to define it, he quotes something of the following nature:

A civil wrong, wherein one person's conduct causes a

> compensable injury to the person, property, or reorganized interest of another, in violation of a duty imposed by law.[150]

In general, this tort law has three major functions and objectives: (1) compensation for the victim of a tort, (2) fairness of that compensation, and (3) prevention of future losses.[151] In spite of these functions and goals, it is a very complicated legal device for eliminating personal losses or harms.[152]

From such a view, Sage describes, in his presentation titled *Liability Considerations in Artificial Reef Development*, the complexity of this issue as follows: "[This presentation would only] scratch the surface of the areas of liability involved in artificial reef development...and [it] does not purport to adequately cover the complexities of the entire body of [tort] law."[153] Furthermore, because of "the lack of [tort] test cases"[154] relative to artificial reef construction, all the analyses of the areas of liability will be hypothetical. Keeping these circumstances in mind, Collins applied three potential tort theories: "negligence," "nuisance," and "strict liability," with respect to any personal injury or property damage associated with artificial reef projects.[155]

A. Negligence

The term "negligence" is based on a general rule that "all persons are under a duty to conduct themselves in all of their

diverse activities so as not to create unreasonable risks of physical harm to others."[156] Thus, whether negligent or not will be considered as following questions: (1) does one have a duty owed to other on a standard of care? (2) is there a breach or a violation of that duty by one who is under a duty? (3) does that breach of a duty cause sufficient injury to other owed on a standard of care? and (4) is there actual loss or damage resulting from that break of a duty?[157]

In a legal concept, Kionka describes that "negligence" does not mean "the absence of carefulness as a state of mind," like forgetfulness or inattentiveness as moral fault. Instead, the legal term "negligence" is defined as the reasonableness of "conduct."[158] In other words, if one's negligent conduct causes an unreasonable harm to others, he may be negligent, regardless of reasonableness of his belief or thought, concerning the safety of others.[159] In general, in judging whether that conduct is negligent or not, a test is whether that conduct is performed by a reasonable person. This reasonable person is not "perfect or infallible," but his errors must be "reasonable or excusable under the circumstances" based on ordinary care--though he can make a mistake or misjudgment.[160]

B. Nuisance

The term "nuisance" could be the interest of a plaintiff who has been interfered with, but is irrelevant to the conduct of the

defendant, unlike "negligence."[161] With regard to artificial reefs, Collins is positive, saying that "a reef could be viewed as a public nuisance if it was improperly sited and a private party was found responsible."[162]

Also, interferences with public convenience during reef deployment by obstructing a navigable stream, by creating any condition which makes other navigation inconvenient, or by crowding small crafts, could be considered as public nuisance. Another example of nuisance would be the aesthetic disturbance by the unsecured scrap tires washed upon a public beach.

C. Strict Liability

According to the degree of tortious fault, three categories of modern tort law include: (1) "negligence," creating an unreasonable risk of harm, (2) "intentional torts," conducting in the sense of intent, and (3) "strict liability," without consideration of fault.[163] The traditional concept of category (3) has developed to modern cases resulting from "abnormally dangerous conditions and activities"[164] (e.g. blasting or storing dangerous substances in large urban area).[165]

To disclose its roots, at first, *Rylands v. Fletcher*[166] must be taken into consideration to define "natural use," or "non-natural (or artificial) use" of the close. If a land-owner lawfully has used his property for certain purposes and a person outside that property was harmed by the product (e.g. debris)

from the operation of the law of nature, then, the land-owner would not be liable for strict liability. However, the land-owner could be liable for non-natural (or artificial) conditions on his premises, if a product of non-natural use escaped from his premises and caused personal injuries, or property damage.[167]

Further, there are still some questions to apply to this case theory of artificial reef construction with respect to the interpretation of terminology--"natural use," or "non-natural use." Regarding its applicability, Collins asks, "what is a natural use? Is an artificial reef just a duplication of a natural use, or is it non-natural?"[168] The application of those terms is not determinable, but amorphous, depending on each different situation. For example, the storage of explosive substances in quantity might bring unusual risks in the midst of a large city, but not in homestead areas. Also, a water reservoir might be a key element in farming areas, but inappropriate in a nearby coal mining area.[169] Thus, a test of whether or not an activity is conducted in an unusual or abnormal dangerous condition is very important to apply the strict liability theory.

Associated with artificial reef sinking, this theory could apply to the deployment of a huge jetliner in navigable water because it could be unusual material as an artificial reef. In the case of sinking a Boeing 727 by Dade County, its fuselage-

sustaining security was attached to ten specialty anchors. But, if some of these anchors are torn off by strong wave action or vandalism,[170] the sunken jetliner might be dislocated from the original permitted site. Then, if that causes damage to a vessel which navigates above the area, this unusual or abnormal use of light-weight aluminum materials in storm and hurricane vulnerable areas might be claimed for strict liability.

3. Defenses to Negligence Liability

A. Reasonable Care

In judging whether the defendant's conduct is negligent, the crucial issue will be the reasonableness of his/her conduct--that is, objective standards of reasonableness.[171] Thus, the proof of the exercise of such "reasonable care" or "due care" by the "reasonable person of ordinary prudence"[172] is a strong affirmative defense.

B. Contributory Negligence

Contributory negligence is when a plaintiff contributes to his/her own injuries.[173] That is to say, if failure of his/her due care for his/her own safety contributes to his/her injury, then he/she may be barred from his/her claiming for compensation because of his/her own fault other than a defendant's negligence.[174] Thus, this theory can serve as another affirmative defense which must be proved by the defendant. In some states,

the proof of contributory negligence is a complete bar to a plaintiff's recovery, but in other states, the proof of contributory negligence has been abandoned based on the adoption of comparative negligence theory.[175]

C. Comparative Negligence

As of 1968, comparative negligence theory had been adopted by only seven states. As of mid-1991, however, 45 states had codified this theory under the strong preferable trend.[176] According to the comparative negligence doctrine, the proof of contributory negligence is not an absolute bar to a plaintiff's recovery for injuries. Instead, his/her recovery is calculated proportionally according to how much a plaintiff's fault bears to the total injuries.[177]

There are two basic proportional calculation methods. First, if a plaintiff is 70% at fault and a defendant 30%, then the plaintiff still can recover 30% of his/her damage. Second is a "50% rule" by which the plaintiff recovers nothing if his/her fault was at least 50% or more than that of defendant.[178]

D. Assumption of Risk

Although a defendant who has a duty of standard care for a plaintiff is negligent, assumption of risk theory can be another defense for a defendant, because the plaintiff knew the risk and chose to encounter it.[179] Assumption of risk doctrine is similar to contributory negligence,[180] but, theoretically, there is a

distinction between the two. Assumption of risk is performed by a plaintiff's voluntary consent to accept a known risk. On the other hand, contributory negligence is created by the plaintiff's "unreasonable conduct."[181]

A typical example is that when a swimmer goes to the beach on a rough day, despite the sign warning the dangerous situation, the swimmer decides to go in anyway. That person has assumed the risk.[182] Concerning artificial reefs, a diver goes down to the artificial reef site and his/her thigh is cut and seriously injured by a sharp reef edge. Consequently, the diver panics and makes an abnormal emergency ascent resulting in lung injury. In this situation, the permittee may be required to assume a certain amount of negligence for not fixing the unusual dangerous sharp reef edge before putting it down on the bottom. But the diver must also assume the risk of fully realizing that there could be unexpected and dangerous situations underwater.[183]

Because of this applicable assumption of risk theory, reef permit holders are customarily more concerned about the inspection for navigational safety soon after a hurricane or a tropical storm hits reef sites, than checking the reef conditions regarding diver safety. In general, the governmental reef permit holders are more flaccid in this issue because divers have to use their own discretionary judgement whether or not to go in, assuming their own risks engaged in their activities.[184]

E. Statutory Compliance

Sage notes, "a violation of the statute or regulation in itself (per se) is negligence."[185] However, to be clearly liable, a defendant's violation of such a statute or regulation must be referred to "proximate cause" between the tortious conduct and its consequences.[186] Accordingly, statutory compliance with permit requirements and conditions are the proof of reasonable care, being immune from liability pursuant to the NFEA Title II sec.205 (c).

4. Sovereign Immunity

An immunity is a complete bar to tort liability claims. This immunity is not a privilege--"negation of the existence of the tort liability"--but a defense to liability.[187] That is to say, a defendant can be sued but his/her tort liability will be immune in this theory. Historically, tort immunity has been given to governments, public employees, non-profit organizations, and between spouses, parents, and children. But with respect to artificial reefs, government entities and non-profit fishing organizations are generally tort-immune units under the doctrine of sovereign immunity.

A. Federal Government

In its original root under common law, the doctrine of substantive immunity came from the concept that "[a] lawsuit

could not be brought against the Crown (the Sovereign) in the Crown's own courts without its consent," as reflected from the divine concept: "[T]he king can do no wrong."[188] In rejection of this anachronistic doctrine, the U.S. Supreme Court ruled in *Cohens v. Virginia* that the United States, founded as the 'Supremacy of the People' and democratic government, could not be sued without its consent.[189]

In this regard, Congress passed the Federal Tort Claims Act in 1946,[190] which contains a number of exceptions, preserving immunity from lawsuits against the federal government. One of the exceptions is that "federal government is not liable for acts done with due care in the execution of a statute or regulation, even though it is invalid,...or the failure to exercise or perform a discretionary function or duty on the part of a federal agency or an employee of the Government."[191] Thus, the applicabilty of immunity theory is depending on whether the federal government or its agencies such as the ACE, the USCG, and the EPA act with reasonable care in performance of procedural requirements mandated by reef permit conditions and regulations

B. State Governments

At the state level, most states have adopted the doctrine of sovereign immunity, and in 1973, the Florida Legislature passed the Florida Tort Claims Act (FTCA),[192] which actually limited the state's tort liability under the concept of no fear of liability,

no precipitation of the public treasury and just public policy.[193] The state is not liable in tort liability "for policy decisions of state officials engaging the exercise of [their] discretion."[194] In general, the FTCA recognized traditional governmental immunity for the action or inaction of judicial, legislative, or governmental functions, but general governmental liability might be waived for proprietary functions of government.[195] The criticism based on the "governmental-proprietary" distinction arises more realistically at the local governmental level.

C. Local Governments

To claim a certain degree of sovereign immunity for local governments under the state level, a distinction between state and local governments results from the concept that municipalities have a dual character: as a branch of government of their parent state and a municipal corporation.[196] Counties are very important local government entities with respect to artificial reef development because most reef permittees active today are coastal counties.[197]

Tracing the rule to its root, the English case of *Russell v. Men of Devon*[198] was followed in the United States so that local governmental immunity was once universally accepted. But it soon became controversial between governmental and proprietary dual functions of local governments. Accordingly, when a local

government acts in governmental or public functions, it is immune from tort liability. But when it acts like a corporate or private entity, its immunity is waived to the extent of a private corporation.[199]

However, there have been substantial disagreement and inconsistency among the cases in distinguishing between governmental and proprietary functions.[200] In 1957, *Hargrove v. Town of Cocoa Beach* initially made a distinction between governmental and proprietary capacity of local governments. With this ruling and a trend of enacting statutes governing the tort liability of state and local governments, the courts began to waive local governments' immunity for proprietary actions.[201] This type of abolition of governmental immunity has become "the trend in many states."[202] Accordingly, government officers or employees are personally liable for their torts, except for performing a discretionary administrative function, or exercising judicial or legislative capacity in good faith.[203]

Liability issue so far has been a restraint for local artificial reef development. This is one of the reasons why private individuals are hardly given permits in Florida. The ACE's Jacksonville District requires that the private individual reef applicant has at least a million-dollar liability insurance policy.[204] In general, a person who holds the permit is responsible for the reef operation. However, liability issues

arising from reef development is not that simple. Who, between state and county, has responsibility for artificial reefs sunk on the state submerged lands by the county? The state has the authority of ownership, management, and jurisdiction in the state territorial waters, whereas the counties hold permits for artificial reefs in these waters. In this situation, neither the counties nor the state take over any title from the original material donors. The material donors, by contract, generally give up their title of authority as soon as the materials touch the bottom of the ocean. Thereafter, who owns these artificial reefs? Nobody really owns those things,[205] indeed, as Mostkoff says, "it belongs to the people of Florida, belongs to the citizens of the United States. Anything we put out there is the public domain."[206]

Most people agree with this public property concept, but which entity is really liable for operating those reef materials? Thomas Clingan, Professor of Law at the University of Miami Law School, notes, "I would not say in the pure sense that the state does not own the artificial reefs."[207] However, to answer this question, one should consider who has exclusive jurisdictional power over them rather than asking who owns them. In this regard, the state has explicitly exclusive jurisdictional authority within state territorial waters.[208]

Today, from the state's point of view, counties seem to be

willing to assume the liability for their reef building and management.[209] But counties are still fearful of liability suits--although they are under the umbrella of governmental sovereign immunity. Pursuant to the NFEA, an artificial reef permit holder is responsible for proper siting, constructing, monitoring, and managing reefs. In practice, counties are reluctant to pass any ordinance, reenforcing any kind of monitoring and regulation of artificial reefs, because once they manage and monitor them, they must bear the implication of responsibility for those activities.[210] Under any circumstance, the most important condition here is that permit holders such as counties must comply with the laws, regulations, and permit requirements that have been mandated. On the other hand, permitters such as the ACE and the FDEP must issue permits through a stringent procedural process.

CHAPTER III
ARTIFICIAL REEF MANAGEMENT ASSESSMENT AND CONTEMPORARY CONTROVERSIAL QUESTIONS

Artificial reef development has been emerging rapidly with growing public interest, because it is one of few management tools that may enhance marine resources[211] lost by estuarine habitat destruction, water pollution, and natural disaster. Nevertheless, many contemporary controversies with regard to artificial reef building exist due to inappropriate materials, haphazard reef construction, insufficient funding, few available scientific data, user conflicts, the attraction versus production debate, and cooperation with local biologists and reef engineers. In this chapter, I discuss and assess the reality of current reef management, and analyze contemporary controversial questions arising from improper artificial reef deployment.

1. Materials

Since the end of 1950's, nation-wide placement of various

reef materials in U.S. coastal waters has been with unsophisticated and frugal "materials of opportunity" because of low cost and convenience.[212] Due to mainly insufficient governmental subsidy, prefabricated materials have seldom been used.[213] In some cases, a great volume of solid waste disposal--in the name of fishery resources enhancement--has been disguised as artificial reef materials.[214] According to the NARP, evaluation of any material to be used as an artificial reef, before its deployment, must articulate distinctly its effectiveness for several characteristics: function, compatibility, durability and stability, and availability.[215]

For function, materials must provide fishery habitats so that the aquatic organisms can grow as much as desired. Compatibility is imperative so that reef materials be in harmony with the surrounding natural environment both physically and biologically. Then, artificial reef materials must be durable enough to resist deterioration, and must be able to withstand exceptional tropical storms or hurricanes. Finally, reef materials must be readily available for easy construction onshore in the most effective but inexpensive ways.[216]

The trend, today, is that waste managers are more than willing to cooperate with reef building for disposition of waste materials as it becomes more difficult to recycle and dispose of them on land.[217] To prevent the disguised ocean dumping of waste

materials in Florida, the FARDP has established state comprehensive standards for screening availability and suitability of reef materials. The FARDP's material criteria include: (1) be environmentally safe, (2) assure maximum longevity, (3) be legally permissible, and (4) be readily available at minimal cost.[218]

Complying with the ACE's General Permit SAJ-50's material requirements, the FARDP has classified three material categories: (1) permissible materials (i.e. vessels, concrete, rocks, etc), (2) prohibited materials (i.e. tires not imbedded in concrete, household appliances, sludge, etc), and (3) materials not recommended for reefs (i.e. toxic or deleterious substances; wooden materials, vehicle bodies, etc).[219]

In August, 1994, reviewing with the FDEP, the ACE's Jacksonville District issued some changes and new conditions to permissible reef materials. Materials approved by this revised General Permit SAJ-50 include concrete and steel culverts, Army tanks and vessels, bridge rubble, concrete blocks, and slabs. But automobile, truck, bus, and other vehicular tires may not be used unless secured and substantially embedded in concrete. Also prohibited are household appliances such as refrigerators, freezers, ranges, washers, dryers, furniture, boat molds, PVC, fiberglass materials, trailers, vehicle bodies, and so on.[220]

Despite the prohibition of some materials and stringent

inspection requirements of all materials, artificial reef deployment has continued through illegal or unpermitted dumping at night to create personal fish havens[221] and in someway like "public relations gimmicks" to promote particular user groups (as constituency).[222] In this environment, the following reef material assessment--though still controversial--will be assuredly helpful for reef developers, when choosing the best materials known to date.

A. Steel Vessels and Barges

During the 1970's and 1980's, steel vessels were the most popular materials in the United States. In accordance with P.L.92-402 (1972) which allowed states to use surplus Liberty ships for artificial reefs, the FDNR sank five such ships, mostly in the Florida Panhandle area.[223]

Especially in the 1980's, the three most active reef counties, Dade, Broward, and Palm Beach, had sunk vessels and barges with ardor,[224] undoubtedly as tourist attractions for diving and recreational fishing activities. Starting with the sinking of the tug boat *Orion* in 1981, Dade County has sunk greater than 40 steel vessels and barges during the 1980's alone.[225] In the beginning of its artificial reef programs, many derelict vessels in the Miami River were abandoned from accidents. They were donated free for artificial reefs. This early circumstance fueled a large amount of vessel-type

artificial reef deployment in the Dade County offshore.[226] But now, at least $40,000-45,000 is needed to get a 250-foot ship for sinking. So reef builders are less enthusiastic in procuring these types of materials.

Except for simple barges and tugboats, steel vessels generally offer good interstitial spaces and complexities as long as "reef builders make efforts to open holes to let the water into the chambers"[227] and, if possible, as many holes as allowable with maintaining complexities. Steel vessels usually have good durability in either fresh water or salt water.[228]

However, sunken vessel stability varies greatly with current, depth, wave surge, and the density of the vessel. The National Park Service Resource Impact Assessment Team with the Dade County DERM had inspected eleven artificial reef sites offshore of Dade County, immediately after Hurricane Andrew on August 24, 1992. They demonstrated that although a steel vessel was moved away or severely modified by a hurricane, other adjacent similar steel vessels remained in position or were structurally unchanged.[229] For example, the *Tarpoon*--a 165-foot steel hulled ship at 71 feet--moved about 204 feet inshore and was no longer identifiable as a ship, whereas the *Steane D'Auray*--a 110-foot steel trawler at 68 feet--1200 feet away from the *Tarpoon*, remained in its original position.[230]

In addition, Ken Banks notes that Broward County's shallow

vessels were in good condition after Hurricane Andrew, whereas vessels in deeper areas such as the *Jim Atria*--a steel freighter at 112 feet--was damaged.[231] Therefore, one may speculate that various factors affect underwater vessel stability because they commonly have a high profile that is vulnerable to tropical storm surges or hurricanes. But vessel stability is still a controversial characteristic in artificial reef construction.

Another criticism arising from sinking vessels for artificial reefs is the use of explosives. For over the last decade, the blast of explosives for opening hulls below the draft line has produced spectacular "pyrotechnic"[232] shows for the media and the boat crowd. Mostkoff, an expert of Dade County ship sinking, explains:

> Dynamiting has impact to fish and kills them. That is a problem, [but] it depends on case by case. For the smaller vessels, they can be sunk without using explosives...But the use of explosives has two main reasons: a quick sinking of a vessel in strong currents and opening completely the inter space for water circulation.[233]

Notwithstanding these reasons, killing fish by using explosives (i.e. more than 300 pounds of TNT to sink the *Mercedes I* in 1985)[234] and bombing from a F-4D Phantom jet (i.e. 500-pound bombs on the 287-foot *Doc DeMilly* in 1986)[235] is very ironic because it iss done on behalf of marine life enhancement. Jim Hardie, a *Miami Herald* reporter, described the day of bombing from a F-4D Phantom jet as follows:

> It looked like a movie scene off Pacific Reef Light in South Dade as the six F-4D Phantom jets made passes for 10 minutes. Pillars of gray-white smoke shot skyward when 200 pounds of dynamite ignited with a boom in the

> hull of the ship. And there were special effects, too--smoke boiled from exploding cans of gasoline and ether placed by the Metro Bomb Squad.[236]

The show was part of an artificial fishing reef project developed by Fish and Game Unlimited of Homestead in cooperation with the Dade County Artificial Reef Program. Noting this irony, Hardie also comments that after sinking about 40 ships during the past decade, these people "wanted some glitter for the previously ho-hum affairs."[237]

Nevertheless, reef builders must not forget that the primary goal of what they are doing is fishery resources enhancement. Accordingly, if sea conditions allow no option other than using explosives, these should be used very cautiously to minimize the detrimental impact on the natural environment. The vessel can be sunk in another manner by opening the seacocks[238] on the permitted reef site.

B. Concrete Rubble, Culverts, and Prefabricated Structures

Concrete material can be generated in thousands of forms,[239] so that various concrete types of configuration and complexities can be produced. Such prefabricated concrete modules were deployed offshore of Haulover Beach,[240] fish condos off Fort Lauderdale,[241] and reef balls in several other experimental areas.[242] Concrete rubble and culverts, according to their size, create a variety of interstitial spaces and surfaces for attracting marine organisms. Concrete materials are extremely

durable in the marine environment.

One thing to keep in mind is that concrete rubble, culverts, or modules should be piled sufficiently high to prevent covering by sediment. Concrete materials tend to act like natural rocks. However, concrete bridge rubble, or culverts are not attractive for divers because they are aesthetically unpleasing and unnatural looking. A limitation in using concrete materials is the requirement of heavy equipment to load and unload them from dock to the reef site.[243]

C. Limestone Rocks and Boulders

Particularly in tropical regions such as southeastern Florida where the benthic substrate is important to attract commercial important species, limestone rocks are "superior" reef materials[244] because they originally come from ancient coral reefs.[245] Also, the stability and durability of such materials are excellent, providing very reliable substrate for invertebrate colonization.[246]

Boulder and rock size can be selected for a variety of shapes and porosities, allowing "the small holes for the small fish and the big holes for the big fish."[247] In this respect, boulders and limestone rocks can be used to facilitate other reefs with poor complexities. For example, two U.S. Army tanks sunk off south Miami beach are relativly simple compared to other reef materials and provide small areas for fish habitats.

However, the Dade County DERM deposited thousands of tons of boulders between these two Army tanks to complement their simple shape.

In spite of many advantages in using boulders and rocks, one difficulty of this material is that in some areas, such as the south Atlantic and the Gulf of Mexico, rocks and boulders are not readily available.[248]

D. Scrap Tires

Under the concept of using "materials of opportunity", millions of scrap tires have been deployed in the United States because of their longevity,[249] potential for alleviating solid waste problems on land,[250] availability in great quantities,[251] and the possibility of arranging them in various configurations.[252] In the early 1970's, the idea of using scrap tires as artificial reefs grew as the disposal of scrap tires had become a major problem on land.[253] Since then, baled automobile scrap tires have become popular artificial reef materials in the United States. These materials were even used by reef researchers because they were regarded as one of the most accessible reef materials.[254]

Nevertheless, use of tires as artificial reefs, today, has been met with growing skepticism by reef permitting agencies and reef builders because of their instability and aesthetic problems. The NARP warned about tire instability on the ocean bottom.[255] It recommended that scrap tires be compressed tightly

and bound in bundles with concrete slabs to keep them in position.[256] Hence, if scrap tires are not ballasted with something like concrete, they might move out of the original drop-site during normal and/or exceptional storm surges.

The Saltwater Sport Fish Section of the South Carolina Wildlife and Marine Resources Department and New Jersey Division of Fish, Game, and Wildlife's Marine Fisheries Administration have actively used scrap tires for artificial reef materials. Among others, Broward Artificial Reef Inc., sponsored by the Broward County DNRP, dropped nearly two millions of scrap tires on submerged lands.[257] When an inspection was made of the scrap tire reefs after a regional storm, it was found that many, particularly cylindrical modules, were washed westerly (towards the beaches).[258]

Furthermore, Shellhorse comments on scrap tires in a negative sense, "coral and other invertebrates rarely attach to tires. Tire reefs serve only to attract fish, not to support them."[259] Similarly, Dodrill was critical of scrap tires:

> The fish does not care about what they look like as long as they are three dimensional objects, providing shelters, habitats, places to go foraging for food. But I'm saying the diving is becoming increasingly popular sport in Florida. [Spread tires are] aesthetically displeasing and I think it's an issue.[260]

E. Auto Bodies

Vehicle bodies are easily available, but many criticize

their suitability for artificial reefs. Pybas points out two reasons why these materials are not adequate for reefs. One is that car bodies corrode very quickly.[261] A good artificial reef must persist for "at least 20 years."[262] A study done in the early 1960's in California showed that car bodies and street cars deteriorated within 3-4 years.[263] Today, because modern car bodies are made thinner and more compact than in the past, the durability factor unequivocally decreases. Another reason is that a storm or any kind of surge can break and scatter car bodies because of their relatively small size.

Indeed, Dodrill criticized the use of auto bodies as artificial reefs that there are real high percentage of non-metal products in an auto body such as plastics and other synthetic products.[264] Auto bodies are not only aesthetically displeasing, but they also may contain pollutants from leftover gasoline, residual oils and lubricants, despite the fact that reef builders make concerted efforts to clean auto bodies and remove the engines.[265]

Likewise, in commenting about auto bodies being used in Alabama's Artificial Reef Program, Bohnsack interjects that auto bodies are not generally considered suitable artificial reef materials because of their short longevity, instability, and their tendency to release "loose materials" as the metal corrodes away.[266]

Nonetheless, as long as cheap auto bodies are readily available, they may be sunk as artificial reefs in the United States under the rubric of fishery resources enhancement, even in the face of skepticism as waste disposal. Ocean dumping is generally imperceptible to the public because materials dumped into the ocean submerge quickly where they are not observed. Today, many divers population can bear witness to what happens to the ocean bottom surrounding artificial reefs.

F. Oil Platforms

There are approximately 4,000 petroleum production platforms in the coastal waters of the United States,[267] about 3,350 of them in the Gulf of Mexico--especially off Louisiana.[268] According to the Minerals Management Service (MMS), 2,000 obsolete oil and gas production platforms will be removed by 2010,[269] because the OCSLA and the Bureau of Land Management's lease agreement require that abandoned oil platforms be removed. In this regard, the rigs-to-reefs concept as an alternative to obsolete oil and gas production platform removal has been examined and has predominantly been used by the State of Florida, Louisiana, and Texas.[270]

Oil and gas platforms in the Gulf of Mexico had been shown to be excellent fish aggregators by fishermen and divers before the rigs-to-reefs concept.[271] The effectiveness of oil platforms for artificial reefs are based on several characteristics: (1)

high profile, (2) no significant impediment to water flow, and (3) easy location by fishermen.[272] Because of their great potentials as fish aggregators and underwater scenery, oil and gas platforms have rapidly become popular artificial reefs for both fishermen and divers.[273] However, because frames of oil platform structures are relatively simple with not many hiding holes for small fish, many criticize that oil platforms are not good enough for producing fishery resources. Thus, these materials could be better used for diving tourism and where the fish have not been depleted.

G. Airplanes and Army Tanks

First of all, these materials are popular dive attractions through good public propaganda for diving tourism. A Boeing 727 commercial jetliner, named *The Spirit of Miami*, became an addition to Dade County artificial reefs in the light of media coverage. It was lowered with cables offshore of Key Biscayne at a depth of 82 feet, and then secured with 10 specialty anchors driven into the sand[274] because the fuselage of the Boeing 727 is made of light aluminum material. One of the greatest issues for this type of artificial reef is how to maintain permanent stability on the ocean bottom during normal tides, currents, or exceptional tropical storm surges.

Also, the simple shape of the fuselage of the Boeing 727 does not provide good fish shelters. To provide complementary

habitats, about two dozen small plastic baskets were placed on the top of the fuselage for small fish recruitment. As a result, one year after its deployment, many juvenile grunts and other small species were observed by divers.

Approximately 3,000 M-48 and M-60 U.S. Army surplus tanks are waiting for transportation from Anniston Army depot in Alabama to be sunk the Atlantic and the Gulf of Mexico as artificial reefs.[275] Dade County has initially sunk two of them off south Miami Beach. Tanks are comparatively heavy (i.e., 48 tons per unit)[276] and have a thick metal surface. Its good stability on the ocean bottom during storm surges is speculated.

However, if only a few tanks are deployed in a given area, they would not provide much space for fish because they are very small units. This type of reef material is criticized because it is labor intensive to clean up all pollutants. All the wheels and transmissions and bearings were sunk with the main tank body, maintaining its original look. Those parts still contain oil and grease that might cause future long-term water pollution when they rust.

2. How Many More Reefs Are Desirable?

Despite many positive opinions in response to the question: "Why are artificial reefs built?,"[277] each person has different views on what proper artificial reef deployment should be. In the past two decades, the number of local artificial reef

projects has skyrocketed in Florida, with reefs being composed of millions of scrap tires, hundreds of vessels, millions of tons of rocks, and many other solid wastes. During this time, lacking scientific information, many of the reefs were sunk haphazardly without knowing which would be successful, which would not, which reef goals would be maximized, and how many reefs could be saturated in a given area.

Mostkoff expresses his own views on quantities of artificial reefs:

> How many more natural reefs do we need? How many natural reefs get destroyed? We replace fraction of the damage of natural reefs with mitigation. We can even begin to replace that natural habitat lost...The fact is that if you look at these impacts, all the artificial reef materials we put out since 1981 have begun to scratch the surface to replace that natural habitat lost. On the other side of the argument is how many artificial reefs you can have before the saturation of the area. My response to this is how many natural reefs you can have before the saturation of the area. If built properly, the artificial reefs will become very complex marine habitats, never duplicating complex cities of natural reefs, but complementing them.[278]

People realize that artificial reefs are alternatives for lost natural habitats, but very little is known about how well artificial reefs have been utilized. As a result, there are many experts to sink artificial reefs, but few specialists to manage artificial reefs well.

Bohnsack criticizes the quantitative maximization of reef materials, "[P]resumably, material will be dumped until no more

materials or rooms are available."[279] Mostkoff proves this criticism, saying:

> When we will stop the dredging, we will stop filling. When we stop impacting natural reefs, we can really slow down on the construction of artificial reefs. Until that time, the best way we can do is to use [an artificial reef] program as an effort to try restoring all these impacts.[280]

With uncertainty as to whether it will be successful or not, the reef builder, at least, should avoid repeating the same type of reef development. Otherwise, the reef builder should make an effort to deploy experimental reefs for data collection necessary for the next reef deposits with more conviction. No-action can be the best alternative when actions can presumably cause future adverse effects on the natural environment. Today, it is about time for the reef builders to ask themselves, "How many more reefs are desirable in our county's ocean boundaries before moving on?" and "Do we have the capability to maintain and manage all the reefs sunk to date?"

3. Political Expediency Versus Science

The first and foremost of major functions of the NARP is to provide guidelines for states and reef builders to develop artificial reefs based on the best available scientific data.[281] If scientific data are available before policy objectives and management strategies are determined, political decision-making can be framed based on available scientific advice.[282] However,

at times, policy decision-making is expedited for political reasons before sufficient scientific information available.

In general, politicians have a tendency to decide the better policy based on available scientific information, whereas scientists are willing to contribute their scientific knowledge into policy decision-makings.[283] In this context, Hildreth noted the distinction between science and political decision-makings. Science provides "what is right, or true, or correct." But it does not tell "what is better."[284] To make the decision of "what is better" is to be debated during the policy-making process.[285] Accordingly, conflicts in policy making will be less to the proportion of available scientific data.[286]

Blaming the lack of scientific information available for artificial reef development, many local artificial reef programs have seemed to be based on more political expediency for tourist attraction and recreational activities than scientific research for enhancing fishery resources as primary goal. With respect to the political expediency on artificial reef deployment, Pybas states that a lot of local reef programs are very politically driven by the County Commissioners, the tourism development people, or the Chamber of Commerce because it is the way to bring the people to the community.[287]

Consequently, great enthusiasm in artificial reef deployment by political expediency for attracting tourist divers

and sports fishermen probably lead to short-term benefits to local economy. But long-term potential detrimental results from misplaced, poorly designed, and randomly procured artificial reefs might result in irreversible harm to the natural ecosystem.[288]

4. Fishing Opportunity Versus Fishery Resources Enhancement

Before reef builders undertake artificial reef projects, they must consider their primary objectives. The NFEA recognized the purposes of artificial reef constructions as: (1) enhancing habitats and fishery resources, (2) enhancing recreational and commercial fishing opportunities, (3) increasing fishery products, (4) increasing the energy efficiency of recreational and commercial fisheries, and (5) contributing to economies.[289] With respect to these objectives, artificial reefs must be produced for fishery resources enhancement, as well as recreational and commercial fishing opportunities.

However, we should understand the reasons why Congress enacted the NFEA. The most important reason was because Congress found that "overfishing and the degradation of vital fishery resource habitats have caused a reduction in the abundance and diversity of United States fishery resources."[290] Therefore, the NFEA's number one emphasis is that artificial reefs must be constructed, designed, and monitored to enhance fishery resources

"to the maximum extent practicable."[291]

Notwithstanding this primary goal, the majority of artificial reefs in the United States have been targeted for providing recreational and commercial fishing opportunities.[292] Therefore, artificial reefs are frequently termed for "fishing enhancement" rather than "fishery enhancement."[293] In this concern, Pybas criticizes that local artificial reef projects provide fishing opportunity for recreational fishermen to have more people fishing and catching better.[294]

Seemingly, reef builders and managers repeatedly state that the prime purpose for reef building is to enhance fishery resources rather than to attract fish or fishermen. Ken Banks wishes, "we would like to actually improve the fish [biomass], not just attract the fish."[295] Furthermore, Jim Vaughn adds:

> We say, our primary goal is to create habitats...And when we say 'enhancing fisheries,' we are not talking about commercial or recreational harvests...We are talking about increasing the overall biomass of fish in coastal waters...Other things like recreational value are secondary to that...I don't think, the country wants to say that commercial fishing is inherently immoral or wrong or that spearfishing is a terrible thing to people to do...Spearfishing, sport fishing, and commercial fishing, these are all legitimate pursuits--perfectly fine things to do, but they do need to be managed in some way; so that you don't have conflicts between the user groups; so that the resources are not exploited; so that everybody gets fair and equitable access to the resources.[296]

However, some biologists and critics are skeptical about what reef builders/managers are purporting. Eklund[297] comments

that reef builders or managers outwardly propagandiz that artifiical reefs are for enhancing fish habitats. It might be false sense that all artificial reefs actually improve the fish habitats.[298] Pybas expresses his skepticism about what reef builders or managers say to increase fish biomass, because the reality is that they want to have better fishing opportunity tomorrow for their constituents. [299]

Since the early 1990's, instead of quantitative reef proliferation, local county artificial reef builders have recognized the importance of research-type artificial reef development in cooperation with local biologists.[300] In practice, as mentioned in the first chapter, they prefabricated concrete structures to mimic the complexities of natural reefs. These efforts, though in the beginning stage, can be the future basis for knowing whether artificial reefs cultivate fish habitats augmenting fishery resources, or merely attract fish contributing to fishermen crowd.

5. Attraction Versus Production

An unanswered crucial question is still the dispute between the contribution of artificial reefs to production of fish biomass versus to fish aggregation from the nearby natural reefs.[301] There is no clear cut answer for this question. Pybas elucidates, "not all reefs are producers, not all reefs are attractors of fish."[302] It really depends on each situation with

many variables such as configuration, complexity, materials, locations, and so on.[303] For example, if an artificial reef is being placed near natural reefs, "it may keep attracting fish from the natural reefs resulting in negative impact on the natural reefs."[304]

However, in flatter and more barren shelf areas such as the Gulf of Mexico, fish can be initially concentrated on artificial reef areas because fish have to swim for quite a long time to find such habitats. In this situation, once the fish settle on the reefs, they will start creating a full ecosystem.[305] Pybas also illustrates that simple but high profile reef structures, such as the *Tenneco II* oil platform, are great attraction for divers and big fish such as amberjack, jewfish, or kingfish seasonally, but not for fish recruitment or production.[306]

Bohnsack and Eklund[307] ponder whether reef fish are limited by habitats or by recruitment. If they are limited by recruitment, it might not matter how many reefs are deposited offshore, because many fish die during their planktonic stage before they ever make it to the reefs. In this case, artificial reefs are not fully utilized for increasing fish production. Furthermore, despite the high planktonic and larval mortality, once they are recruited onto the reefs, then the issue depends on whether or not there are enough proper reef habitats, providing shelters from predators. Thus, post-settlement predation might be

a very important issue if there is a successful production of fish biomass. Eklund will soon disclose this issue in her ongoing research project off of Key Biscayne, Miami.

Once colonized by adult fish and recruited by juveniles, many factors contribute to the viability of their residence, survival, growth, production, and reproduction. Bohnsack enumerates such factors: (1) reef volume, 2) reef height, 3) complexity with different hole sizes and number of internal spaces, 4) texture and composition of reef materials, 5) prefabrication of reefs concerning spatial arrangement and orientation, 6) site selection, and 7) reef history.[308]

Achieving the above contributing factors, artificial reefs will provide additional food chains, increase feeding efficiency, facilitate shelters from predators, create recruitment habitats, and allow replacement for the natural habitats lost.[309] Among others, enough proper shelters from predators are the most vital for juvenile recruitment and their high survival rate, increasing future fish biomass.[310] In general, artificial reefs that are composed of greater complexities attract higher fish densities, similarly to natural reefs.[311]

Relative to the size of a shelter, numerous experiments demonstrate that artificial reefs with large holes consistently manifest low fish densities, species poorness, and more predators than reefs with relatively small holes. This result was

attributed to the fact that fish abundance was proportional to the intensity of predators, and the large holes are not safe enough for small fish refuge.[312] Hence, providing the different sizes of shelters is crucial for both predators as home sites and their small prey fish as sanctuary from predation.[313]

Therefore, the issue between attraction versus production really depends on a variety of situations and contributing factors as above mentioned. From this perspective, Bohnsack concludes:

> Attraction and production are not mutually exclusive and can be considered opposite extremes along a gradient. While artificial reefs may merely attract and concentrate some fishes, they may promote the production of others. Most fishes probably lie somewhere between the two extremes.[314]

In this context, a reef builder might not have to be anxious that artificial reefs have merely to produce fish biomass increase. But he/she has to consider how proper artificial reefs are utilized as fishery management tools. Bohnsack recommends that even if an artificial reef serves merely as fish concentrators from a nearby dispersed fish population, reef builders and managers use them as fishery management tools for increasing catchability, only where:

> (a) fishing effort is low,
> (b) a large stock reservoir exists relative to catch,
> (c) fish density is too low to be efficiently fished without artificial reefs,
> (d) high rates of stock immigration exists, and
> (e) little natural reef habitat exists.[315]

6. Monitoring and Research as Necessity

In the past, the terms monitoring and research have been "often considered unimportant or of secondary importance for management."[316] Bohnsack voi in this reality that monitoring should be "a necessity before we inadvertently do irreparable damage to our natural resources by continued deployment of waste materials."[317] Buckley agrees that it would be reckless if one continues to deploy artificial reefs for reasons other than research or fishery resources enhancement. He also accentuates, "any deployment must be evaluated by fishery managers and researchers to determine if the proposed artificial reefs can produce the desired effects without causing overriding adverse impacts."[318] Without monitoring, in other words, one cannot gain any information, determining which reef is successful, which is not, or what environmental adverse effects occur.

Currently, there are several reasons why reef builders and managers are reluctant monitors and researchers. The first is funding-shortage. Generally speaking, most of reef builders blame a lack of monitoring and research on a lack of money. More than that, while most reef grants are for reef construction and transportation, not a single penny has regularly gone to monitoring and research, except for special reef monitoring and research projects. Some funds from mitigation projects or Saltonstall-Kennedy Grant Program[319] administered by the NMFS

provide support, but are very limited to special reef research and development projects.

Dodrill analyzes in detail the funding situation with respect to reef building in Florida.[320] Encouraged by the NARP, in the beginning of 1986, the Federal Aid in Sport Fish Restoration Program of the FWS started to obtain funding from taxes on motor boat fuel, fishing tackles and equipments, and imported boats.[321] This money was distributed based on each state's population of fishermen. Since 1986, Florida State has begun to receive that money (about $300,000 a year). This federal money was divided into twelve 25,000-dollar grants. Then, Florida State was required to match 25% of the total amount of the grants, resulting in a 100,000-dollar contribution.

Consequently, the federal program contributes 75% of the match ($300,000), and the 25% ($100,000) comes from Florida State, through fishing license fees from both fresh water and salt water. Now, this makes up sixteen 25,000-dollar grants. That means, a maximum of sixteen different projects can apply for this money. To date, 25 of 34 counties in Florida have applied for these grants so that there has been some level of competition to obtain this money.

In addition to the above grants, Florida State provides another $500,000 that goes for artificial reef construction. In the case where somebody has a real innovative project that

involves prototype artificial reef module construction, one can apply for some of this additional money to the basic $25,000 grant.

The grants mentioned thus far are strictly limited, and are to be spent on either construction or transportation of artificial reefs. For this, over a million dollars are funded annually for reef development in Florida from both federal and state support, but there is no funding for monitoring. As a result of this restriction, artificial reef procurement is speeding up because there is money, at least, to bring reef materials out to the sites.

In accordance with this contradiction, the FARDP points out, that the biggest drawback is that this money is not "flexible enough to serve the unpredictable aspects of artificial reef program activities."[322] Also, Butler notes in the same mode, "we have had exponentially increasing development of artificial reef sites. We need, instead, exponential development of research and monitoring on artificial reef function, and research on experimental larvae and juvenile reefs which might truly enhance our resources."[323]

At this point, it is about time to steer the use of some grants towards monitoring and research projects. Dodrill expresses his sentiment on this issue:

I think, the resistance to monitor in the past, on the

> part of general fishing public, is because they know [artificial reefs] attract fish. They do not want to spend their own money doing long-term scientific studies. They just want to have places to go fishing and catch fish out there. That has been the driving force why. Over 2 years ago, we tried to change rule to allow [money for] monitoring, and we took it to public workshops...They say, "Aren't you gonna waste money for monitoring? You should be building more reefs." My feeling is that Florida got far more reefs out there than any other states. I think, it is about time for some long-term planning to come into the whole state operation.[324]

A second reason is the reef manager's negligence on what artificial reef rules require. The NFEA section 205 (b) stipulates that the primary reason for monitoring programs for reef management is to ensure compliance with all applicable provisions defined in the laws, regulations, and permitting requirements concerned artificial reef development.[325] The NARP also recommends "performance monitoring" to provide understanding of physical, biological, socio-economic impacts on given artificial reef sites.[326] Especially, initial monitoring procedure to determine if artificial reefs deployed underwater have been maintained in compliance with all the various reef requirements must be exercised without excuse.[327] In reality, many reef permit holders have been somewhat negligent of this duty, methodically blaming the lack of funding[328] and fear of liability.[329]

Finally, scientific reef research through consistent monitoring programs is complex and costly, and will be wearisome

until the necessary information is gained. Political constituents who are the major funding support for reef development might be querulous about spending their tax money on experiments for long-term scientific results. No matter what hard circumstances there are, reef managers, in cooperation with local biologists, must look for long-term goals, evaluating valuable scientific and management information to test their hypothetical experiments.

Otherwise, without preparation of such a "fishery stock impact analysis"[330] by monitoring, we might see an ironic situation, wherein fish stocks are overexploited, that an irresponsible reef builder might continue spending more money for greater number of artificial reefs, saying that this may increase fish habitats. What if the reefs deployed in the overexploited area play the role of aggregators? If so, these reefs may help increase fishermen's catchability, but will doubly decrease fishery stocks.[331] Thus, evaluation of fishery stock data collected through monitoring will help prevent long-term irrevocable negative impacts to natural resources.

CONCLUSION: EFFECTIVE FUTURE MANAGEMENT

Generally speaking, fishermen want as many artificial reefs

as possible, and divers continuously want to explore newly developed reefs. In an effort to satisfy these reef user constituents' demand, the political expediency has procured a great number of artificial reefs in Florida. It has not only brought many benefits to the public, such as attraction of recreational tourists, mitigation, reduction of user conflicts, disposal of "materials of opportunity," fish habitat enhancement, and promotion of efficiency for boating divers and fishermen to the reefs, but it also has raised many uncertainties regarding the consequences of the following: decentralized artificial reef programs, haphazard artificial reef development, fear of liability, disguised disposal of certain types of industrial waste, obscurity of artificial reef prime function, unsolved question between attraction versus production, and no financial support for monitoring.

From this perspective, to furnish proper artificial reef development instead of haphazard reef deployment, now is the time for reef builders and fishery managers to look back, realize

today's reality, and determine the future direction for the most efficient but the least environmentally detrimental reef management. Therefore, to minimize the above mentioned

uncertainties and maximize a reef's merits, four future priorities in artificial reef building and its less controversial management are recommended strongly in this conclusion.

A. Master Plan

No matter with what obstacles reef builders and managers are confronted, they must establish a master plan for each site-specific artificial reef development. In this view, one might argue that not everything can be executed according to the master plan because there is no such things as a perfect master plan. However, developing a reef site without a master plan is comparable to a ship departing from the dock without a compass or a destination.

Today, reef coordinators voice that the preparation of comprehensive artificial reef management plans are necessary at the county level.[332] However, there still has been very little action in this direction. As they continue to move on without well-planned action, reef builders and coordinators will be dubious about any progress in the future. Consider the following three coordinators' sentiments on this belief.

Broward County Coordinator, Ken Banks:

> We gonna keep this thing until we learn something new to do. We gonna continue to do what we do until we learn something important to change.[333]

Palm Beach County Coordinator, Jim Vaughn:

> We'll continue basically the way we're doing until more money is available for monitoring or learning more

> about construction. It's one of the things that called for a comprehensive plan for managing the sites at what point you reach the buildup, at what point you have enough and don't need to build up anymore, and at what point you just need to maintain them. That question hasn't been answered at this point.[334]
>
> Dade County Coordinator, Ben Mostkoff:
>
> Have you followed the master plan?...Here is our master plan. Our master plan is to try to keep the pace as best as possible without destruction of natural reefs...In fact, if there is more money coming into this program, it will probably come in not for biological research but tourism reason. There is a push right now for a master plan for destination 2001 being worked out by the Commissioner's Appraisal Office.[335]

In this context, they might be able to keep pace with what they have been doing so far, but they may not be able to predict where they will be tomorrow.

In this future uncertainty, artificial reef programs might be dragged easily by various political constituents' taste, because there are a variety of reef builders with background in administration, solid waste management, engineering, clerking, or volunteering, but seldom marine biology. To overcome this difficulty, each coastal county is urged to hire at least one full-time staff in charge with artificial reef programs only. In this respect, Dade, Broward, and Palm Beach County--the most active counties in artificial reef programs in the state--are certainly in position to be the lead partners for picturing the reef site-specific master plans under comprehensive county

artificial reef management plans.

B. More Centralized Comprehensive Artificial Reef Development Plan.

Unlike many other states with relatively short coastlines, such as North Carolina and Alabama, Florida's artificial reef development and management strategies have been decentralized[336] because of its highly diverse geographic features and long coastline.[337] This decentralization has allowed individual counties or private parties to develop their own site-specific artificial reef based on their individual conventional reef strategies. With no doubt, this phenomenon has naturally contributed to Florida State being labelled as the number one artificial reef state in terms of quantity.

However, to reduce current controversies caused by the decentralized artificial reef development method, the state has to exercise more control on the following issues. First, if a state agency holds a reef permit and develops artificial reefs in a given area, that might enable the state to coordinate the balance between the need for nursery-type artificial reef habitats to enhance more biomass and the request for user-type artificial structures to provide fishing and diving pleasures.[338]

Second, as a state agency holds a permit in a specially designated area in behalf of private parties' artificial reef

deployment, it might be able to control and prevent chronic illegal, unpermitted, or uninspected dumping of reef materials, as well as unpermitted placement, by local irresponsible individuals. For example, on October 12, 1994, the FDEP gained a permit for individual parties' artificial reef deployment in three specially designated large areas in the Panhandle: Escambia West, Escambia East, and Okaloosa. Under the permit requirement, the FDEP has responsibility and liability to directly oversee in these areas any individual's reef materials dumping.

Traditionally, this Panhandle area has been known for illegal "midnight reef" dumping by the commercial charterboat fishing industry. However, under this state's permit holding, the FDEP--whether in state or federal waters (only referred to no federal preemption and no conflict with the ACE's permission in federal waters)--allows private parties to deploy only natural limestone rocks, clean concrete prefabricated materials, clean concrete rubble, heavy gauge construction grade steel materials, selected surplus military equipment or vessels, and prefabricated artificial reef structures.[339]

Third, under the five-year-term general permit system, local reef permit holders can deploy any applicable materials anytime, as many as they want, within permitted areas during the five-year-term. No one argues that this is illegal, but there are obviously some disputes in this system, because the state reef

agency cannot control the numeric quantities of local artificial reef procuring in state waters. The state reef agency has been regularly reported only the reef information that is related to the grants given through the state's hand.

Consequently, the state reef agency hardly supervises or advises comprehensively over reef development by private or county entities, whether or not there is any adverse impact to the environment or the special relationship of those materials to each other. To make the more centralized artificial reef development system work, local artificial reef builders and coordinators' corporation is strongly needed to drive it successfully. If they are negligent in cooperating with the state-wide controlled programs, then the state may need to hold them in funding hostage[340] to make them collaborate. In this situation, Dodrill hopes to see that the counties commence to prepare their own five-year plans like "what are your plans by the year 2000?"[341]

Despite these constructive criticisms, there are, in practice, many obstacles which make their implementation difficult. More than any other, poor funding is the biggest blockade to hiring enough full-time personnel for dive-monitoring, data-basing, and material overseeing at the state level. Dodrill describes this realistically, "half of my salary is paid by the federal grant. When the federal grant runs out in

two years if they don't renew it, I don't know what will happen to this position. The other two positions which work for me...are being paid totally by the salt water fishing license money, not by the general revenue. So, just three people can't run the state-wide programs."[342]

Moreover, the capability of practicable law enforcement is a very debatable question on oversight of illegal or unpermitted activities associated with artificial reef construction. The USCG and the Florida State Marine Patrol (FMP) can join the environmental law enforcement teams in the FDEP. But the USCG has traditionally been more interested in the matters such as navigational safety, illegal immigration, and drug enforcement--especially in south Florida. The FMP is also busy daily with enforcing marine pollution and small craft safety. They reserve little capacity to dispense for other jobs including artificial reef construction permitting regulations.

C. Artificial Reef Complex

Grove and Sonu have introduced a hierarchy of Japanese reef development from "reef set" through "reef group" to "reef complex." A reef complex can be eventually generated by accumulation of reef groups, functioning as independent ecosystem.[343] Keeping this in mind, reef builders are encouraged to keep trying to deploy reef materials closely to form a reef complex, rather than haphazardly spreading out reef materials

over the given area. By doing so, there are many beneficial advantages to reduce some contemporary contention arising from artificial reef construction.

First of all, the reef complex might alleviate unsolved dispute between attraction versus production of artificial reefs. As reef builders deploy a variety of different sizes and types of materials with multifarious dimensional configuration continuously in one large area, we can speculate that this reef complex could create independently a full-cycle of certain marine organisms. It would provide for larval, juvenile, and adult fish with greater choices of shelters and current shadows. It also could produce a variety of hiding holes from predators, resulting in greater survival rate.

Second, this reef complex may take tremendous pressure off the coral reefs and other natural fish habitats such as natural rocks. In general, divers plan two open water dives per trip, except for special diving purposes. The first dive is made at a deeper artificial reef site, and shallower coral reefs for the second. So, there is a fifty percent chance to go diving in coral reef areas. This is a common phenomenon in the dive sites where artificial reefs and natural reefs are nearby each other. However, if the reef complex is composed of great diverse underwater attractions, such as naval vessels, barges, and mimics of sunken ancient villages, many of divers may not move over to

coral reef areas, spending their dives within the reef complex.

Finally, the worry about easily catching fish over artificial reef sites as playing a role of attraction might be alleviated, because a wide area of reef complex where is functioning as a full independent cycle of ecosystem generates the dispersion of fish, resulting in low fish catchability. Likewise, a wide reef complex provides enough spaces for a number of fishing boats, reducing tension between competitors.

D. Local Artificial Reef Advisory Committee

One other mechanism that might be able to reduce problems caused by the decentralized artificial reef development scheme is the creation of regional or local artificial reef advisory committees. These committees, at the county level or regional level, can advise many things based on biological, socio-economic, and recreational and commercial fishing aspects. Under the laws, regulations, and permit requirements, this advisory committee should supervise and advise, guiding the direction of local artificial reef programs which, otherwise, might be possibly manipulated by a single person such as an individual permit holder, or county artificial reef coordinator.

This artificial reef advisory committee should be composed

of seven members: two from the local government (one being the director of natural resources division, one being the artificial reef coordinator), two with a biological background (one from an academic field, one from a governmental institution), one representing the dive community, one from the commercial fishing industry, and finally, one from a recreational fishing club. Because it is composed of an odd number of members, the advisory committee does not have to exhaust time and energy in deciding reef projects by casting a majority vote. Also, being composed of members from various backgrounds, this committee will inherently consider political, administrative, biological, theoretical, socio-economical, sociological, and aesthetical standpoints.

In summary, artificial reef deployment in the United States has multiplied tremendously with great potential for natural resource enhancement, facilitated by an abundance of "materials of opportunity." However, using the excuse of the shortage of funding and scientific uncertainty, many artificial reef materials sunk in the United States have been procured with growing national difficulties of the disposal of solid waste materials on land, raising some skepticism about long-term irreversible negative impacts to the natural environment. Concerning the transition from quantity to quality, Florida State and its counties confront time to endeavor in preparation of

site-specific master plans, reorganization for more centralized reef plans, creation of reef complex, and establishment of local artificial reef advisory committees. These management strategies have to be executed urgently to lessen the contemporary reef management controversies and ultimately accomplish enrichment of marine resources in the future.

ENDNOTES

INTRODUCTION

1. Stone, 1974, p. 24-25.

2. Ino, 1974, p. 21-22, and Sheehy, 1981, p. 185.

3. The term "enthusiasm " relative to artificial reef deployment often has been used in Dr. Bohnsack's editorial., 1987, p. 2-3, and Bohnsack and Sutherland, 1985, p. 11.

4. Schmied, 1988, p. 13. At national level, the NMFS plays a great role in responsible plans for fishery resources management, conservation, and development on behalf of the Secretary of

Commerce.

5. 16 U.S.C.A. sec. 1801-1882.

6. Ibid., 1852(a).

7. P.L. 98-623, Title II.

8. McIntosh, Jr., 1981, p. 99.

9. Myatt, E. N., and D. O. Myatt, III. 1992. *Florida Artificial Reef Development Plan*. Under contract to Organization of Artificial Reefs, Tallahassee, the book was prepared for Florida DNR, Division of Marine Resources, Office of Fisheries Management and Assistance Services.

10. In 1992, Fla. Sea Grant College Program prepared for the FDNR the *Environmental and Fishery Performance of Florida Artificial Reef Habitats: Guidelines for Technical Evaluation of Sites Developed with State Construction Assistance*.

11. Pybas, 1991, p. 6-40., and Pybas and Seaman, 1988, p. 8-10.

12. Goldberg, 1994, and Mostkoff, 1994.

13. Bohnsack and Sutherland, 1985, p. 31.

14. Meier, 1989, p. 1051, and Mostkoff, 1994.

15. Stone, et al. 1991. In the United States, artificial reefs are deposited mainly by disposal of "materials of opportunity," which are generally cheap and readily available. (i.e., industrial solid wastes, scrap tires, auto bodies, bridge rubble, concrete culverts, household appliances, etc.).

16. Schmied, 1988, p. 13.

17. Milon, 1989, p. 836.

18. Forsgren, 1988, p. 39-40.

19. Schmied, 1988, p. 13.

20. Bohnsack and Sutherland, 1985, p. 11. They pointed out that, in lack of knowledge about reef design criteria, location, and size, the number of artificial reefs have been increased under enthusiastic public support and considerable governmental funding

aid for artificial reef construction.

21. MacDonald, 1994, p. 108.

22. 86 Stat. 614 (1972), 46 U.S.C. sec. 1114-1177. The act was passed to authorize appropriations for maritime programs of the Department of Commerce.

23. P.L. 98-623, Title II.

24. Ibid., sec. 203.

25. Stone, 1985a.

26. National Marine Fisheries Service, U.S. Fish and Wildlife Service, Environmental Protection Agency, Minerals Management Service, U.S. Coast Guard, and U.S. Army Corps of Engineers.

27. Stone, 1985a, p. v-vi.

28. 43 U.S.C.A. sec. 1331-1356.

29. 10 Fed. Reg. 12303 (1945).

30. 43 U.S.C.A. sec. 1331(b).

31. Ibid., sec. 1331(q).

32. Ibid., sec. 1334(a).

33. Ibid., and sec. 1301(e).

34. 30 C.F.R. sec. 280.11.

35. 16 U.S.C.A. sec. 1531-1544.

36. 16 U.S.C.A. sec. 1361-1421h.

37. 16 U.S.C.A. sec. 1536(a)(2).

38. Ibid., sec. 1536(b)(4).

39. 16 U.S.C. 742a-742j, 70 Stat. 1119.

40. P.L. 88-309, 78 Stat. 197 (1964).

41. 16 U.S.C. sec. 742f(a).

42. P.L. 88-309, sec. 3(a).

43. P.L. 81-681.

44. In July of 1984, the Wallop-Breaux Amendment to the Federal Aid in Sport Fish Restoration Act (Dingell-Johnson Act) eventually established a new trust fund referred to as the Wallop-Breaux Trust Fund of 1984. See detail in Christian's.

45. 16 U.S.C.A. sec. 1801-1882.

46. Ibid., sec. 1852(a).

47. Ibid., sec. 1852(b)(2)(A & B).

48. 16 U.S.C. sec. 742j, and P.L. 88-309 (1964).

49. 33 U.S.C. sec. 403.

50. 43 U.S.C.A. sec. 1333(e).

51. P.L. 92-500, October 18, 1972.

52. 33 U.S.C. sec. 1251 et. seq.. The Federal Water Pollution Control Act of 1972 was amended by the Clean Water Act of 1977.

53. 33 U.S.C. sec. 1401-1445.

54. P.L. 91-190, and 42 U.S.C. sec. 4321 et. seq..

55. 16 U.S.C. sec. 1451 et. seq..

56. 33 U.S.C. sec. 1251(101)(a)(1).

57. 33 U.S.C. sec. 1401(b), and sec. 1412(a).

58. 42 U.S.C. sec. 4232(102)(2).

59. Power, 1977, p. 503-59.

60. 430 F.2d. 199 (5th Cir. 1970).

61. 16 U.S.C. sec. 1456.

62. 14 U.S.C. sec. 81.

63. Ibid., sec. 83.

64. Ibid., sec. 83-85.

65. Mostkoff, 1994.

66. Ibid., sec. 1413.

67. Ibid., sec. 1413(d).

68. 33 U.S.C. sec. 1401(b).

69.Ibid., sec. 1412(a).

70. Ibid., sec. 1413.

71. Stone, 1985a, p. 6.

72. Pursuant to Laws of Florida 1993, C.93-213 sec.3, FL Stat. sec.20.255 (supp.1994). "All of the existing legal authorities abductions of the Department of Environmental Regulation and the Department of Natural Resources are transferred to the Department of Environmental Protection,." effective July 1, 1993.

73. Myatt and Myatt III, 1992, p. iii-iv.

74. Andree, 1988.

75. Myatt and Myatt III, 1992, p. 1-2, 1-3.

76. s. 370.0605 F.S..

77. s. 370.25 F.S. (1991).

78. s. 370.25(1) F.S. (1991).

79. Fla. Chapter 16R-9F.A.C.(1990).

80. Fla. H. B. 1303, (1994).

81. Fla. S. B. 554, (1994).

82. Stevely, et al, 1994.

83. 120.721 F.S. annot.

84. See Executive Director, Responsibility to Board of Trustees

of Internal Improvement Trust Fund. (370.017.F.S. annot.).

85. Latch, 1978, p. 14-15.

86. s. 253 F.S., and s. 258 F.S., and Chapter 18-21, F.A.C.

87. Chapter 18-21.005(1)(a)8, F.A.C.. See Fitzgerald, 1988, p. 24.

88. F.S. sec 20.255 (supp.1994).

89. Stone, 1985a, p. 7.

90. Halusky, et al., 1993.

91. Ibid., p. 4.

92. Ibid., Appendix C.

93. Mostkoff, 1994.

94. Banks, 1994.

95. Vaughn, 1994.

96. See detail in the "Joint Application forms and Instructions (Condensed) for Wetland Resource Alterations (Dredging & Filling) in the Waters of Florida" by U.S. Army Corps of Engineers, Florida Department of Environmental Regulation; Florida Department of Natural Resources, effective May 31, 1991.

97. Myatt and Myatt III, 1992, P. 5-2.

98. Ibid.

99. "Public Notice SAJ-50: Artificial Fishing Reefs and Fish Attractors in Florida," 1994.

100. See in detail "Public Notice SAJ-50," Aug. 51, 191994. In short to describe basic criteria: 1) suitable plans and drawings, 2) No artificial reefs in hazard to or from vessel navigation, 3) No artificial reefs in shrimp, fish, shellfish traveling areas, 4) All marking requirements in accordance with the U.S.C.G.'s requirements, 5) No permit authorization around national historic sites, parks or marine sanctuaries, 6) No permit authorization on submerged beds of sea grasses, coral reefs or other valuable habitat, and 7) No permit authorization on areas where may affect endangered species.

101. Joint Application Forms and Instructions, p. 13.

102. Myatt and Myatt III, 1992, P. 5-2.

103. Goode, 1981, p. 57.

104. Ibid., p. 58.

105. Adams, 1988, p. 16-17.

106. Myatt and Myatt III, 1992, p. 5-6.

CHAPTER 2

107. Myatt and Myatt, III, 1992, p. 5-7.

108. "Public Notice SAJ-50," 1994, p. 5.

109. P.L. 98-623, Title II, sec. 205(c)(1).

110. Ibid., sec. 205(c)(2).

111. Ibid., sec. 205(c)(3).

112. Ibid., sec. 205(c)(4).

113. Ibid., sec. 205(a)(1).

114. Ibid., sec. 205(a)(2).

115. Ibid., sec. 205(a)(3).

116. Ibid., sec. 205(a)(4).

117. Stone, 1985a, p. 61.

118. Myatt and Myatt III, 1992, p. 5-7.

119. Stone, 1985a, p. 61, and Collins, 1984, p. 1.

120. Stone, 1985a, p. 62.

121. Collins, 1984, p. 14-16.

122. Ibid., p. i.

123. Myatt and Myatt III, 1992, p. 5-7.

124. Stone, 1985a, p. 62.

125. 43 U.S.C.A. sec. 1301-1315.

126. *U.S. v. California*, 332 U.S. 19, 67 S.Ct. 1658, 91 L.Ed. 1889 (1947).

127. Ibid., 20(5).

128. Ibid., 35-36.

129. 43 U.S.C. sec. 1314(a).

130. Christie, 1991, p. 91.

131. 43 U.S.C.A. sec. 1301(2) & 1312.

132. *U.S. v. Florida*, 363 U.S. 21 (1960).

133. 43 U.S.C.A. sec. 1331-1343.

134. Ibid., sec. 1331(a).

135. Ibid., sec. 1332.

136. Ibid., sec. 1333(e).

137. Ibid., sec. 1311(a).

138. 16 U.S.C.A. sec. 1811.

139. Christie, 1991, p. 99.

140. 313 U.S. 69, 61 S.Ct. 924, 85 L.Ed. 1193 (1941).

141. Ibid., 70-71.

142. Ibid., 72.

143. *Toomer v. Witsell*, 334 U.S. 385, 68 S.Ct. 1156, 92 L.Ed. 1460 (1948). *Torao Takahashi v. Fish and Game Commission*, 334 U.S. 410, 68 S.Ct. 1138, 92 L.Ed. 1478 (1948).

144. 546 P.2d 530 (Alaska, 1976). See more detail in *Uri v. Alaska*, 429 U.S. 806, 97 S.Ct. 40, 50 L.Ed.2d 66 (1976).

145. Christie, 1991, p.97-98, and Hildreth and Johnson, 1982 p.196.

146. Christie, 1991, p. 109.

147. Ibid., p. 109-112.

148. Stevely, et al., 1994, p. 1.

149. Kionka, 1991, p. 1.

150. Ibid., p. 4.

151. Ibid., p. 5-11.

152. Ibid., p. 4.

153. Sage, 1989, p. 1. In November 1988, Al Sage, Professor at the University of Mississippi Law Center, was invited to review and discern liability issues associated with artificial reef development at the Atlantic States Marine Fisheries Commission's Artificial Reef Committee Meeting in Norfolk, VA.

154. Sage, 1989, p. 1-2.

155. Collins, 1984, p. 8.

156. Kionka, 1991, p. 47.

157. Kionka, 1991, p. 47-48, See also Sage, 1989, p. 1-2, and Collins, 1984, p. 8.

158. Kionka, 1991, p. 48.

159. Ibid.

160. Ibid., p. 50.

161. Ibid., p. 273.

162. Ibid., p. 9.

163. Kionka, 1991, p. 31, and Sage, 1989, p. 2.

164. Kionka, 1991, p. 35.

165. Ibid., p. 33-34.

166. 3 H. & C. 774, 159 Eng.Rep. 737 [1865], 1 Exch. Ch. 265 [1866]. As a leading English tort case, Defendants, mill owners in Lancashire, constructed a reservoir on their property to use water for their mill. The water broke into a Plaintiff's abandoned coal mine and made it flooded. The lower court held in favor for Defendants, but on appeal, the Exchequer Chamber decided to impose strict liability by using analogies.

167. Kionka, 1991, p. 36-37, and Collins, 1984, p. 10.

168. Collins, 1984, p. 10.

169. Kionka, 1991, p. 38.

170. Hardie, 1994, p. 18C. On December 10, 1993, *Miami Herald* reported vandalism that divers had undone some bolts that connect the wings to the fuselage or specialty anchors. On February 27, 1994, *Miami Herald* secondly reported that vandals were destroying the specialty anchor system, causing a dangerous situation. At then, three of the ten anchors were disabled. Stephen O'Neal, donor of the airplane, has offered a $1,000 reward for information of vandals.

171. Ibid., p. 49.

172. Sage, 1989, p. 3, and Kionka, 1991, p. 49-50.

> The reasonable person is...a creature of the law's imagination. He or she is not the average or typical person, but rather an idealized image of such a person--a composite of the community's judgement as to how the typical community member ought to behave in each of the infinite variety of circumstances and activities in which there is a potential or actual risk of harm to the actor or others. (Kionka, 1991, p. 50)

173. Sage, 1989, p. 3.

174. Kionka, 1991, p. 105-108.

175. Sage, 1989, p. 3, and Collins, 1984, p. 10-11.

176. Kionka, 1991, p. 109.

177. Ibid., p. 110, and Collins, 1984, p. 11, and Sage, 1989, p. 3.

178. Kionka, 1991, p. 110.

179. Ibid., p. 115, and Sage, 1989, p. 3.

180. Sage, 1989, p. 3.

181. Kionka, 1991, p. 126.

182. Clingan, 1994.

183. Ibid., 1994, and Mostkoff, 1994.

184. Mostkoff, 1994.

185. Sage, 1989, p. 2.

186. Kionka, 1991, p. 77.

187. Ibid., p. 341.

188. Ibid., p. 342.

189. *Cohens v. Virginia*, 19 U.S. 264. (1821).

190. 28 U.S.C.A. sec. 1346, 1402, 1504, 2110, 2401, 2402, 2411, 2412, 2671, et al.

191. 28 U.S.C.A. sec. 2680(a).

192. F.S. 768 et. seq. (1977).

193. Kionka, 1991, p. 346.

194. Ibid., p. 347.

195. *Hargrove v. Town of Cocoa Beach*, 96 So.2d 130 (Fla.1957), and Kionka, 1991, p. 349.

196. Kionka, 1991, p. 347.

197. Pybas and Seaman, Jr., 1988, p. 8-12.

198. 2 Term Rep. 667, 100 Eng.Reg. 359 (1788).

199. Kionka, 1991, p. 348.

200. Ibid., p. 348.

201. Ibid., p. 349.

202. Collins, 1984, p. 11.

203. Kionka, 1991, p. 350.

204. Dodrill, 1994.

205. Vaughn, 1994.

206. Mostkoff, 1994.

207. Clingan, 1994.

208. Ibid.

209. Dodrill, 1994.

210. Vaughn, 1994.

CHAPTER 3

211. Bohnsack, (editorial), 1987, p. 2.

212. Stone, 1985b, p.3-9, and Stone, et al., 1991, p. 1-6.

213. Stone, et al., 1991, p. 3.

214. Bohnsack, (editorial), 1987, p. 3.

215. Burke, 1986, p. 20.

216. Ibid., p. 24-26.

217. Myatt and Myatt III, 1992, p. 9-1.

218. Ibid., p. 9-2.

219. See in detail Myatt and Myatt III, 1992, p. 9-1 to 9-8, and "Public Notice SAJ-50," 1994.

220. "Public Notice SAJ-50," 1994, p. 2.

221. Stevely, et al., 1994, p. 1.

222. Bohnsack, (editorial), 1987, p. 3.

223. Demoran, 1981, p. 92.

224. "Artificial Reef List" from Dade, Broward and Palm Beach County. Over 60 vessels in Dade, 29 vessels in Broward and 7 vessels in Palm Beach County.

225. "Artificial Reef List" from Dade County DERM.

226. Mostkoff, 1994.

227. Pybas, 1994.

228. Stone, 1985a, p. 27.

229. Blair, et al., 1994, p. 971.

230. Ibid., p. 968.

231. Banks, 1994.

232. Bohnsack, (editorial), 1987, p. 3.

233. Mostkoff, 1994.

234. Rimkus, 1985, p. 7B.

235. Hardie, 1986, p. 1B.

236. Ibid.

237. Ibid.

238. According to his personal talk, Dr. Bohnsack, Reef Research Biologist in SEFC, NMFS, NOAA, was against the pyrotechnic use of explosives. He supported using seacocks to open the hull for sinking vessels.

239. Shellhorse, 1994, p. 26.

240. Degnan, 1993. p. 11D. The concrete pipes with jagged limestone rocks were molded with cement. Fifty of the modules were sunk in March 1993, on the 68' sand bottom offshore of Haulover area, as mitigation of natural reefs damaged by Hurricane Andrew in August, 1992.

241. Zaneski, 1994. p. 1BR. 60 concrete "fish condos" were deployed in Fort Lauderdale offshore by Broward County and Nova Southeastern University Research Team--the lead researcher, Dr. Richard Spieler.

242. Simonaltis and Shellhorse, 1994. p. 1 & 26. Reef Ball Development Group Ltd., based in Doraville, Georgia, developed an inexpensive, durable, attractive and easily deployable concrete prefabricated reef ball.

243. Shepard, 1974, p. 137.

244. Goldberg, 1994.

245. Shellhorse, 1994, p. 26.

246. Stone, 1985a, p. 32.

247. Eklund, 1994.

248. Stone, 1985a, p. 32.

249. Tolley, 1981, p. 86.

250. Myatt III, 1974, p. 81-83.

251. Shepard, 1974, p. 137.

252. Stone, 1985a, P. 31.

253. Shepard, 1974, p. 137-138.

254. Stone, 1979, p. 2.

255. Stone, 1985a, p. 31.

256. Ibid., p. 31.

257. Tolley, 1981, p. 88.

258. D.E. Britt Associates, Inc. 1975, p. 1-11.

259. Shellhorse, 1994, p. 1.

260. Dodrill, 1994.

261. Pybas, 1994.

262. Wilson, 1991, p. 23.

263. Sheehy, 1982, p. 6.

264. Dodrill, 1994.

265. Pybas, 1994.

266. Bohnsack's "Letter to Mr. Tom Wallin, Chairman GOMFMC," October 4, 1994. p. 1.

267. Iudicello, 1989, p. 791.

268. Ditton and Falk, 1981, p. 96.

269. Iudicello, p. 791.

270. Quigel and Thornton, 1989, p. 799.

271. Ibid., p. 799-800.

272. Shinn, 1974, p. 96.

273. McGurrin and Fedler, 1989, p. 777-778.

274. Nachoum, 1994, p. 38.

275. Lawther, 1994, p. 3.

276. Ibid.

277. Meier, 1989, p. 1051.

278. Mostkoff, 1994.

279. Bohnsack, (editorial), 1987, p. 3.

280. Mostkoff, 1994.

281. Stone, 1985a, p. v.

282. Holden, 1994, p. 88.

283. Hildreth, 1994, p. 165.

284. Ibid., p. 164.

285. Ibid.

286. Ibid., p. 163.

287. Pybas, 1994.

288. In Bohnsack, (editorial), 1987, p. 3, he admonished reef builders, although research will be difficult and costly, to evaluate and monitor reefs to avoid future accidental irreparable damage to natural environment.

289. P.L. 98-623, Title II, sec. 202(a)(5).

290. Ibid., sec. 202(a)(2).

291. Ibid., sec. 203(1).

292. Stone, 1985a, p. 13.

293. Butler, 1988, p. 36.

294. Pybas, 1994.

295. Banks, 1994.

296. Vaughn, 1994.

297. Ann Marie Eklund, research biologist of SEFC, NMFS, NOAA

298. Eklund, 1994.

299. Pybas, 1994.

300. For example, 50 coral rock modules specifically designed by Mostkoff himself and Harold Hudson were sunk last year offshore of Haulover Beach, with research projects of Dr. Walter Goldberg, FIU. The number of pyramid-like fish condominium and concrete modules were used in Broward County offshore, focusing on collecting scientific information, during last two years by Dr. Richard Spieler and his graduate research students sponsored by Broward County DNRP. Some concrete modules were deposited on the estuarine area in the Indian River by Palm Beach County, which Ann Marie Eklund monitored for scientific data. Dr. Bohnsack, Ann Marie Eklund and his other researchers have participated in the artificial reef research project off Key Biscayne for a decade. Finally, Dr. Bill Lindberg's Swannee River artificial reef research project has been done for 3 years, in corporation with the DEP and local county artificial reef coordinators.

301. Bohnsack, 1989, p. 631.

302. Pybas, 1994.

303. Ibid.

304. Goldberg, 1994.

305. Pybas, 1994.

306. Ibid.

307. Bohnsack, 1989, p. 633-635. Bohnsack explicates reef fish ecology with four factors: life history, habitat limitation, recruitment limitation, and fishery exploitation. Also, on her interview, Eklund considers attraction versus production issue with whether reef fish are limited by habitats or recruitment. She is conducting research on this question off Key Biscayne, Miami.

308. Bohnsack, 1985, p. 20-23.

309. Bohnsack, 1989, p. 631.

310. Ibid., 1991, p. 414.

311. Ibid., p. 416.

312. Ibid., p. 417.

313. Hixon and Beets, 1989, p. 678.

314. Bohnsack, 1989, p. 637.

315. Ibid., p. 641.

316. Ibid., (editorial), 1987, p. 3.

317. Ibid.

318. Buckley, 1989, p. 1054-1055.

319. Federal Register 57(95): 21704-21080, and Myatt and Myatt III, p. 5-14.

320. Dodrill, 1994.

321. Dodrill, 1994, and see more detail in Christian, *Dingell-Johnson/Wallop-Breaux:* 2nd edition, p. 1-5.

322. Myatt and Myatt III, 1992, p. 5-11, 5-12.

323. Butler, 1988, p. 36.

324. Dodrill, 1994.

325. P.L. 98-623, Title II, sec. 205(b).

326. Stone, 1985a, p. 58-59.

327. Ibid., p. 57.

328. Mostkoff, 1994.

329. Vaughn, 1994.

330. Milon, 1989a, p. 842.

331. Polovina, 1989, p. 1057.

CONCLUSION

332. At the Artificial Reef Coordinators' Meeting in Sarasota on 22 October, 1994, John Stevely, University of Florida Sea Grant Extension Agent, re-emphasized the importance of preparing comprehensive county-level artificial reef management plans. All the participants unquestionably agreed on this suggestion. But, to my knowledge so far, none of coastal counties in Florida have developed any formal reef management plans or site-specific master plans.

333. Banks, 1994.

334. Vaughn, 1994.

335. Mostkoff, 1994.

336. Pybas and Seaman, 1987, p. 8.

337. Myatt and Myatt III, p. iii.

338. Pybas, 1994.

339. Dodrill, 1994a, p. 2.

340. Pybas, 1994.

341. Dodrill, 1994.

342. Ibid.

343. Grove and Sonu, 1985, p. 228.

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